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July 2, 1999 *CTC*/RGS-CL1803-99

U.S. Army TACOM-ARDEC
ATTN: AMSTA-AR-ET (Mr. D. Tolliver)
Building 172
Picatinny Arsenal, NJ 07806-5000

SUBJECT: Environmental Protection Agency Electronic Reporting Benefit/Cost Justification Report, dated June 30, 1999

REFERENCE: (1) Task No.: N.092, "Technology Transfer Support for Environmental and Regulatory Information Access and Exchange Through Electronic Commerce," approved January 27, 1997

(2) Contract Number DAAA21-93-C-0046

Dear Mr. Tolliver:

Concurrent Technologies Corporation (*CTC*) is pleased to submit two (2) copies of the Subject Report in accordance with the Reference (1) Task under the Reference (2) Contract. If you should require technical clarification, please call Mr. Robert Shark, Electronic Commerce Technical Specialist, at (814) 269-6858. For contractual issues, please call the undersigned at the above direct dial number.

Very truly yours,

// Original Signed //

Raymond G. Shrift
Manager, Contract Resources

/crm

Enclosures: as stated

cc: Mr. M. Leopard, US EPA

Technology Transfer Support for Environmental and Regulatory Information Access and Exchange Through Electronic Commerce

Environmental Protection Agency
Electronic Reporting Benefit/Cost Justification Report

June 30, 1999

Requests for this document shall be referred to:

Commander, US Army Armament Research
Development and Engineering Center
Industrial Ecology Center
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Contract No. DAAA21-93-C-0046
Task No. N.092
Task IV, Subtask 3

Submitted by

Concurrent Technologies Corporation
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MANAGEMENT SUMMARY

The U.S. Environmental Protection Agency (EPA) is charged with protecting the nation's air, water, and soil from pollution and hazardous substances. To accomplish this, large amounts of information is transferred via paper documents within the EPA, between the EPA and the regulated community, and state and local governments. The federal government and EPA are attempting to reduce this reliance on paper through various means, including using electronic commerce for environmental compliance reporting.

The EPA has had electronic reporting initiatives underway for several years. However, the full benefits from electronic commerce utilization have not been realized. This is primarily due to lack of cultural acceptance of electronic reporting both internal and external to EPA.

Concurrent Technologies Corporation (*CTC*), through the National Defense Center for Environmental Excellence (NDCEE), was tasked to quantify the costs and benefits associated with electronic commerce, examine alternative electronic commerce approaches to conventional Electronic Data Interchange (EDI), assess electronic commerce security issues and products, and discuss the features of an existing program that assists trading partners in electronic commerce implementation. This report documents the results of that study.

Although the use of electronic commerce has grown steadily over the past two decades, frequently, the motivation for implementation has been a mandate by a large trading partner. Often, this is due to a lack of knowledge regarding the benefits of electronic commerce and a resistance to change business practices. Also, the cost of implementing electronic commerce, including computer hardware and software, personnel time and educational expenses, communication costs, and other intangible costs such as re-engineering legacy business systems and processes are a significant constraint. However, benefits, which are contingent on the volume of transactions, integration of electronic commerce with internal computer systems, and elimination of parallel systems, can be substantial. The following chart contains examples of documented savings in various organizations within the government and private sectors. (This information, researched by Concurrent Technologies Corporation (*CTC*), does not constitute an endorsement of any product or service by the EPA.)

Organization	Calculated or Estimated Savings
Texas Instruments (TI)	Average cost to process a purchase order from $49.00 to $4.70
J.C. Penny	Over $1 million saved in postage costs annually
K-Mart	84% reduction from the cost of a manual purchase order to an EDI purchase order
Bank of Chicago	Savings between $3.75 and $6.50 per document
Veteran's Administration	Cost per invoice from $3.48 to $1.55; net savings of $12 million discounted over 5 years. Cost per Government Bill of Lading (GBLs) from $10.07 to $4.52 each
Defense Logistics Agency (DLA) Defense General Supply Center	$24.5 million in savings with its Paperless Order Processing System (POPS); eliminated paperwork and reduced inventory and depot costs
Department of Commerce	99% reduction in paper processed by the Bureau of Export Administration in the issuance of export licenses

In addition to conventional EDI, the EPA is exploring the use of alternative electronic commerce technologies to simplify electronic reporting and to enable a greater number of organizations to participate. Standards-based EDI via the Internet using products such as Premenos' Templar are now available and have enhanced functionality, reliability, and security. This will lower communications costs by reducing or eliminating the reliance on costly Value Added Networks (VANs) and leverage the Internet's infrastructure to reach out to a larger number of reporting organizations. In addition, revolutionary new approaches can be used which deploy a compliance report on a Web site accessible through a standard Web browser. This approach has EDI translation software residing in the background, making EDI transparent to the reporting organization and will further enhance the value of the Internet as a reporting mechanism.

This move to electronic reporting cannot be done without careful consideration of security issues such as authentication, non-repudiation, access control, and information integrity. The EPA must revise policies and strategies as new security features and products become available, reliable, and affordable. Secure transmission of compliance reports, which can be traced back to responsible corporate representatives, is critical due to the legal nature of the documents and is possible with currently available technology.

To overcome the cultural resistance to electronic commerce and electronic reporting in the private sector, the EPA can observe the impact of the National Electronic Commerce Resource Center (NECRC) Program sponsored by the Department of Defense (DOD). This program is designed to assist the DOD supplier chain in implementing electronic commerce by providing awareness, education, and technical support for various electronic commerce technologies. In addition, the Technology Development Activity (TDA) of the NECRC provides the DOD with up-to-date information and technical assessments on evolving technologies, and aids in filling gaps between commercially available hardware and software products. The ECRC Program model can help the EPA pursue and successfully achieve electronic commerce strategies and goals.

Studies performed by numerous organizations show that electronic commerce and EDI make economical sense. Although a clear business case exists for electronic commerce in a wide cross

section of government and private organizations, electronic commerce is just one tool in re-engineering business practices of the EPA and the regulated community. As technologies and standards progress, strategies should be revisited and revised when necessary. The EPA needs to consider every available innovative solution, re-engineering practice, and resource to aid in meeting the challenge of reducing the reliance on paper forms. This will help achieve the goals of reducing costs, decreasing paper use, streamlining information flow, and enhancing the public's access to environmental information.

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1.0 INTRODUCTION

1.1 EPA Overview

The U.S. Environmental Protection Agency (EPA) protects the nation's air, water, and soil from many types and sources of pollution and environmentally hazardous substances. The EPA accomplishes this task by ensuring that federal environmental laws are implemented and enforced effectively. Environmental protection is an integral part of U.S. policy, and environmental risk reduction is based on the best available environmental and scientific information accessible to the federal government and the private sector. Since its inception in 1970, the EPA is responsible for numerous environmental achievements including:

- decreasing emissions of particulate matter by over 75 percent
- preventing one billion pounds of toxic pollution from entering the nation's waters annually
- reducing the disposal of toxic substances into deep wells and landfills by 57 and 44 percent, respectively, and
- completing over 141,000 clean-ups of underground storage tanks.

These accomplishments were achieved through a comprehensive program of monitoring, reporting, and tracking the release, transport, and disposal of environmentally harmful substances. Large amounts of labor-intensive paper work for the EPA, state and local governments, and private business and industry are required to maintain these programs.

1.2 EPA Electronic Reporting Background

The federal government and the EPA are working to reduce this paper-intensive environment, maximize efficiency, and reduce errors through various means, including electronic commerce. Currently, the EPA is taking advantage of electronic commerce benefits by using Electronic Data Interchange (EDI). EDI refers to a technology which allows two or more organizations to exchange information electronically, thereby eliminating the need for paper. Furthermore, the EPA wants to increase its use of electronic reporting by expanding its use of electronic commerce, that is the operation of any form of business activity using electronic methodologies. This will involve not only an increased use of EDI, but also an increase in other electronic reporting mechanisms such as EDI via the Internet and Internet-based electronic forms accessible through a Web browser.

In July 1990, the initial policy for EPA electronic reporting was first published. In 1994, an Electronic Data Interchange Implementation Workgroup (EDIIW) was formed to develop an implementation approach that was compatible with other EDI practices in federal agencies and the private sector. The EPA released an interim policy for electronic environmental reporting on September 4, 1996.

This policy explained how the EPA EDI reporting program would function, the Personal Identification Number (PIN) system and procedures, legal status of electronic submissions, and the EPA's version of a Trading Partner Agreement (TPA), the Terms and Conditions Agreement (TCA).

1.3 Electronic Commerce/Electronic Data Interchange Initiative Overview

Although the EPA policies have been in place for several years, implementation of electronic reporting and EDI has been slow within EPA operations. As with many private and governmental organizations, cultural acceptance of electronic commerce continues to be an issue for EPA and reporting organizations. Also, difficulties with business and industry in capturing environmental information electronically, legal implications of electronic reporting, and the EPA's internal task of integrating EDI with existing computer systems has contributed to its slow progression. Similar obstacles have been identified by large firms in the private sector and other federal agencies, such as the Department of Defense (DOD).

The National Electronic Commerce Resource Center Program (NECRC) is being leveraged to assist the EPA in overcoming barriers to this initiative. EDI courses and expertise supporting the ECRC Program are being enhanced for EPA electronic reporting purposes. When completed, the courses will meet a variety of EPA EDI reporting needs.

Originally EPA's first major electronic commerce effort was to focus on using EDI to report Discharge Monitoring Reports (DMRs) to the EPA's Permit Compliance System (PCS) to demonstrate the effectiveness of assisting trading partners to use EDI. However, due to a delay in the implementation of using EDI for the DMR, the initial focus has shifted to emphasize EPA EDI initiatives in general, rather than DMR specific implementations. Basic and advanced EDI courses are being customized for EPA purposes, and outreach, training, and technical support sessions will be conducted. The NECRC, through its expertise in electronic commerce, information management, environmental regulations, engineering, and technology, is supporting the EPA by providing this assistance to companies, agencies, and municipalities.

Due to the change in focus of the initiative, benchmark data and cost/benefit information associated with DMR implementation will not be captured as anticipated. Concurrent Technologies Corporation (*CTC*), through the National Defense Center for Environmental Excellence (NDCEE), was tasked to leverage existing business and industry information and studies to examine the costs incurred and benefits achieved in implementing electronic commerce. In addition, discussion topics will include alternatives to conventional EDI, electronic commerce security issues and technology, the ECRC Program approach and model, and examples where trading partner assistance for organizations to implement electronic commerce has proven valuable.

2.0 THE BUSINESS CASE FOR ELECTRONIC COMMERCE AND ELECTRONIC DATA INTERCHANGE

Environmental reporting requires large amounts of labor-intensive paper work involving state and local governments and private industry. The federal government and the EPA, in ongoing efforts are attempting to reduce paper-intensive compliance reporting processes, eliminate duplicate reporting to state and federal agencies, and reduce the submission frequency for some reports. Electronic commerce remains a key ingredient in the addressing all three-- providing tools for EPA to maximize efficiency, reduce data entry and information processing time, and decrease reporting errors and rejections.

The cost and benefit information illustrated in this section will leverage existing statistical data and industry studies to quantify the business case for implementing EDI. Documenting and publishing the benefits achieved by other organizations which have implemented electronic commerce will encourage additional organizations to use electronic commerce for submitting reports. It will also help to establish the EPA as a leader in the effort to minimize the impact federal reporting requirements have on business and industry.

2.1 Cost/Benefit Justification Analysis Overview

Performing a cost and benefit analysis is an important ingredient in developing a viable electronic commerce strategy because it helps to justify electronic commerce within an organization and to potential trading partners. Unfortunately, obtaining hard, quantitative data reflecting the impact of electronic commerce on business is scarce. Many organizations do not devote the time and resources necessary to gather costs and quantify benefits. Frequently, technology is implemented as a strategic investment. Intangible benefits are obtained such as competitive advantages due to improved service. Organizations who first implement this technology gain intangible and usually short-term benefits. Competitors typically respond to the challenge and erode the advantage. However, as the trading partner base grows in size, tangible benefits, such as cost savings, will increase.

Distinguished organizations, such as the Logistics Management Institute (LMI), the EDI World Institute, and the Gartner Group, have performed cost benefit analyses and case studies in an effort to quantify expenditures and cost savings for using electronic commerce. These studies focused on large organizations similar in size to EPA that already have made electronic commerce, usually EDI, an integral part of their everyday processes. These large organizations are the driving force in the increased use of EDI. Typically, they are better able to assess and document the effectiveness and tangible benefits associated with their EDI initiatives. Although most of the studies focus on using EDI in traditional business activities, such as procurement, invoicing, and order processing,

parallels between the cost and benefits for these situations can be made for most electronic commerce implementations.

On the other hand, the EPA also exchanges a large amount of information with many small to medium-sized enterprises (SMEs). SMEs often lack the resources to implement electronic commerce and effectively measure the benefits and cost savings that will be gained. In most instances, an SME's entry into the world of electronic commerce is a necessity solely to prevent them from being excluded in an already competitive market. This entry is usually EDI technology but can also be other technologies, such as bar coding for product labeling. Larger trading partners and prime contractors often require SMEs to adhere to electronic commerce mandates. In these instances, analysis of benefits and costs are disregarded and the intangible benefit of keeping the business takes precedence.

Current business and industry statistics indicate the distribution of business transactions transmitted via EDI and are shown in Table 1.

Table 1. Types of transactions exchanged via EDI (based on *CTC* research)

Type of Transaction	Percentage
Purchase Orders	44
Invoices	24
Shipping Notices	14
Credit/Debit Notes	3
Other Types	15

These statistics will likely shift to a higher percentage of "Other Types" as business and industry embrace EDI throughout their business and manufacturing processes. Purchase orders and invoices have traditionally been the starting point for EDI implementation.

Organizations which have existing EDI capabilities will not incur normal startup costs. These organizations will be expanding EDI capabilities and will already have purchased EDI translation software, Value Added Network (VAN) connectivity, and may have integrated EDI to business and manufacturing applications. The cost to expand EDI implementation to environmental reporting will include an increase in VAN charges and a one time expense for analysis and programming for the integration of the new EDI application.

It is possible, depending on the needs and strategy of an already EDI capable organization, that a stand alone EDI capability, separate from a current EDI program, could be implemented. The cost for this capability would be comparable to EDI startup costs, unless the business could leverage existing EDI expertise and personnel to facilitate the environmental implementation. This

approach could be used to simplify data collection from various stand alone sources, to centralize responsibility for environmental EDI, to combat a lack of computer resources to support current business processes, or to address electronic reporting security issues.

As mentioned earlier, the original intent of the task in support of creating this document was to capture specific cost/benefit data from pilot companies which used EDI for submitting the DMR would provide the baseline information and benchmark data to determine the cost and benefits of using EDI when submitting environmental information and reports. However, due to the delay in the implementation of DMR, baseline information will not be captured as part of this effort. Instead, traditional business activity and information about EDI implementation, costs, benefits, and problems encountered will be used.

2.2 Reasons for Implementing Electronic Commerce and EDI

An examination of the history and growth of EDI is helpful to understand the rationale behind an organization's implementation of electronic commerce technologies and standards. The progression of electronic commerce depends on the requirements of the particular industry sector. Certain industry sectors became leaders in EDI utilization because massive amounts of information exchange made EDI a prerequisite to stay in business. Other industry sectors and groups have been late entries into the EDI arena because EDI standards had not evolved and matured sufficiently to support their requirements.

2.2.1 EDI History and Growth

In the 1960s, industries, such as the grocery, transportation, and chemical industries, began a cooperative effort to develop EDI industry standards for purchasing, transportation, and financial applications. However, many of these standards supported only intra-industry trading. Others, such as standards for bills of lading, purchase orders, and invoices, were applicable across several industries. As EDI use grew to encompass the business activities of diverse organizations, the idea of national, cross-industry standards began to receive substantial support. EDI use in the United States and worldwide has steadily increased since its introduction in the late 1960s.

In the late 1970s, the pioneering work of the Transportation Data Coordinating Committee (TDCC) and the National Association of Credit Management's Credit Research Foundation fostered the development of the first national standards for EDI. In 1979, the American National Standards Institute (ANSI) Accredited Standards Committee (ASC) X12 subcommittee was charged with the responsibility of creating and defining

national, cross-industry EDI standards. One of the primary objectives of the X12 subcommittee in developing the ANSI X12 series of standards was to minimize the need for users to reprogram internal computer systems to effect interchange. These standards provide a common format and translation of electronic information that is intelligible to both the sender and the receiver, and is independent of computer platforms and operating systems. Therefore, firms in different industries and of different sizes which engage in distinct types of businesses can exchange data electronically. Today, ANSI X12 is the most commonly used standard in North America.

In 1980, approximately 2,000 U.S. companies were using EDI; by 1990, the number had increased to 22,000. Presently, EDI is used in over 50 industries including the automobile, pharmaceutical, grocery, health care, and manufacturing industries. Between 1989 and 1992, annual growth of registered EDI was greater than 70 percent annually. In the United States, it is projected that over 33% of businesses will be connected to the internet by the year 2000.

EDI use extends across international, national, state, and local governmental and private organizations. Annual surveys conducted by the EDI Group, Ltd. and published in *EDI Forum* have shown that the use of EDI in the United States has grown steadily. Nearly one quarter of those surveyed in 1993 anticipated implementing EDI within two years and 20 percent were already using EDI. The number of companies with no EDI plans fell dramatically during the late 1980s and early 1990s.

EDI is being used in all major industries, and at both federal and state government levels. EDI participants include organizations from small businesses to the world's largest shipper, the DOD. A continuation of this steady and significant growth is predicted based upon plans of major companies, their suppliers, and customers. By 1993, EDI was the second most common method of exchanging business documents in the United States. Paper remained at number one, but had fallen by nearly 50 percent since 1988.

General Motors, Boeing, and General Electric are considered pioneers of EDI and drove the early use of EDI. These organizations became involved in EDI because of their business relationships with thousands of suppliers. They realized the inefficiencies of paper document systems and its effect on their overall efficiency. For these companies, the move to EDI has proven extremely valuable.

2.2.2 Reasons Organization Implement Electronic Commerce and EDI

The reasons large organizations implement electronic commerce is to reduce cost and errors, enable faster and more efficient customer service, and to remain competitive. A primary reason for the success of EDI initiatives for large companies was issuing an EDI mandate to smaller trading partners. Large companies became EDI pioneers partially because of their efforts to force their trading partners to implement EDI. This "convincing" often comes in the form of an EDI mandate. However, EDI implementation often proves to be a difficult task among smaller companies with less resources. Large companies have the financial resources to implement EDI and the power to require trading partners to use EDI. The EDI directive, "either become EDI capable or lose our business," has caused smaller companies to enter the EDI arena out of fear. To lose business to a competitor who uses EDI could be the end for a small business unless that volume is recaptured in other areas. Despite the benefits of EDI, most small companies implement EDI because a trading partner requires it, even though the benefits are not as great for a small company with a low volume of EDI trading.

The following paragraphs identify and discuss the primary arguments for adopting EDI and electronic commerce methodologies:

Customer Requirement. Satisfying a key customer's request to do business electronically is a key reason for adopting EDI, particularly for smaller organizations. However, once EDI capable, properly marketing that capability can provide a strategic advantage by expanding your business base to other EDI trading partners. This has led to creation of publications such as the EDI Yellow Pages, published by Phillips Business Information, Inc., and a national, electronically accessible database of organizations using EDI, developed by Thomson Financial Publishing.

Cost savings. EDI can provide significant cost savings through shorter lead times, improved delivery service, reduced mailing costs, and more efficient use of personnel. Manufacturers and distributors have reported that while processing paper purchase orders costs about $25 to $40 each, EDI processes the same documents for as little as $5 each. Statistics vary from company to company and are dependent on volume and level of integration with business processes.

Improve operations. Many organizations can improve internal efficiencies with EDI. Conducting business electronically means less re-keying of data, less reliance on the conventional mailing providers, shorter order cycles, fewer lost documents, service delays and errors, and reduced freight premiums.

Improve information access and processing. Totally integrating EDI into a company's business and manufacturing software applications can reduce labor requirements. Purchase orders move between company order entry systems, invoices flow directly into customer's accounts payable systems, and rebates are imported directly into sales and cash management systems. There is less re-keying of data, transactions occur on a more timely basis, mail delays are eliminated, and voice miscommunications are reduced.

2.2.3 Barriers to Electronic Commerce/EDI Implementation

As with technology in general, there is a degree of resistance to using electronic commerce and EDI. The following assumptions are often made within organizations and cited as reasons for not pursuing EDI:

- EDI will change my processes and the way business is conducted
- EDI will destroy the relationship I have with my customer/supplier
- EDI is too complex to understand and difficult to implement
- Trading partners will receive all the benefits from EDI
- EDI costs too much
- EDI will provide competitors access to proprietary data
- EDI creates legal problems
- EDI eliminates an audit trail
- EDI communications are not secure
- EDI takes away cash flow advantages
- EDI standards are always changing—we should wait.

The most common reason for not implementing EDI is that a trading partner refuses to participate. Industry growth and technology advancement has reduced concerns over costs and compatibility.

In order to maintain current business relationships with customers or suppliers, many companies are finding that EDI is required. EDI users have been pressuring their trading partners to adopt EDI since it was first introduced. The most commonly cited reason for implementing EDI was strong customer demand. If a company has not already been approached by a trading partner with a request to implement EDI, it is very likely that it will occur in the near future. It is estimated that 33 percent of all U.S. companies will be EDI capable by the year 2000[i].
Education is necessary to overcome resistance to EDI and organizations need to include both staff and management in this endeavor. As with all major decisions in a company, electronic commerce implementation requires the support of upper management if it is to be successful. Lack of education is one of the largest obstacles to widespread acceptance of EDI. Training is available through a variety of sources such as industry conferences, seminars, and user groups. Courses are also available

through many private organizations and government-funded sources, such as the Electronic Commerce Resource Center Program (ECRC) sponsored by the DOD. In addition, training may be available from successful EDI users or trading partners, as well as from consultants, service bureaus, VANs, or software vendors.

In summary, the reasons and justifications for implementing EDI depend on the size, motivation, and resources of an organization. The EPA has taken the position to not force electronic reporting on the private sector. Organizations will not likely comply unless it makes business sense to do so. Therefore, the EPA needs to consider its electronic reporting policy and ensure that the most cost-effective, user-friendly approaches to electronic report submission are readily available.

2.3 Costs for Implementing Electronic Commerce/EDI

Although electronic commerce and EDI might seem like a remedy to frustrated executives trying to contain costs, it is not without its challenges. Depending on the size of the company and particularly the platform on which the EDI system is placed, the cost can be significant. A generally accepted rule is to double the cost of the EDI software to get an estimate of the entire cost of implementation. (Based on *CTC* research) However, this rule ignores the cost of integrating EDI with internal business and manufacturing applications to gain the maximum benefit. A significant systems analysis, design, and programming effort is required to integrate EDI and take full advantage of EDI initiatives. For small businesses, this may require consulting fees or software vendor expenses to customize business and manufacturing commercial off-the-shelf (COTS) software products which support the organization. In many cases, small businesses cannot afford integration expenses. The costs of implementing EDI include software, personnel, training, communications, and intangible costs such as eliminating parallel systems and process re-engineering. These costs are discussed in the following sections.

2.3.1 Software Costs

EDI capabilities are provided through EDI translation software. EDI software translates information from/to an unstructured, company-specific format into a structured EDI format, usually the ANSI X12 standard. It may also provide communication capability to send and receive the information once it is formatted into the standard. The communication software handles the transfer of information between organizations through a third party network or VAN, or directly to a trading partner's computer through a point to point telephone link. The communication software is often included with the EDI translation software or can be purchased from the EDI translation software vendor for an additional fee.

EDI mapping software is another consideration and is used in conjunction with translation software. This software facilitates integration of EDI transactions with business and manufacturing applications. Mapping software may or may not be included as part of the translation software depending on the EDI software vendor. Frequently, mapping software is an add-on module to a base EDI translation software product at additional cost.

The other ingredient in EDI integration is application interface software. It can be purchased and developed internally by an organization's information systems staff or by EDI consultants. This can be handled in some cases by commercial off the shelf (COTS) translation software, which now have the capability to map directly to a table. COTS interface software will often need modifications to fit the information needs of the company and its EDI trading partners. The cost for development depends on the scope of the EDI project. An examination of similar systems, request of bids from consulting firms, and an approximation of the costs from the EDI software vendor can be used to estimate the cost of the application interface.

Inexpensive products may have hidden costs. For example, low-end products may be limited to working with one trading partner. Additional trading partners can be added at an additional cost and may require an upgrade to a different product. Some packages include the communications capabilities while others do not. All EDI software products have annual maintenance fees which provide updates or fixes to the software when required, updates to the standards supported by the package, and various levels of technical support. In the end, a package with higher initial costs may actually save money over the life of its use.

Since EDI software operates on different computer platforms with different capabilities, its price depends on the hardware and operating

system platform. A mainframe translation product may cost more than $100,000. Mini-computer products may range from $20,000 to $50,000 with UNIX platform products costing $5,000 to $20,000. PC products range from $500 to as high as $15,000. Table 2 depicts representative costs and characteristics for EDI software products. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 2. Representative EDI Software Costs

Product	Vendor	Price/ Maintenance	Characteristics
Data Mail	Advanced Communications Systems	$1650 -$6,000/ $595 yr.	PC-based EDI translation software, supporting all ANSI X12 and EDIFACT standards. Supports async. & bisync. communications.
TrustedLink Commerce	Harbinger Corporation	$2,040/ $195 yr.	Stand alone or allows a PC to act as front-end to other PCs or mini/mainframe applications. Supports ANSI X12.
SpEDI*tran	St. Paul Software	$2,700 - 40,000/ 15% yr.	EDI translation package for UNIX, PC mainframe based platforms. Designed for integration into client/server EDI environment.
Trading Partner PC	TSI International Software, Ltd.	$1495/ $600 yr.	EDI translation program. Supports ANSI X12, EDIFACT, and TDCC. Can utilize WWW, Internet, public network or direct communications.
Trading Partner MVS		$80,000/ 18% yr.	Mainframe EDI software (MVS); include Mercator mapping module
STX for the Microcomputer	Supply Tech, Inc. (subsidiary of Harbinger Corporation)	$2495/ $55 month maintenance.	EDI system utilizing ANSI X12, TDCC and EDIFACT standards. Multilingual. Connects with all VANs and private networks.
GENTRAN - family of products	Sterling Software	$500-$150,000 Maintenance varies by platform	All major platforms; on-line translation, auditing, mapping, forms integration, job scheduling
Products for AS/400, PC, RS/6000, etc.	Premenos Corp.	$2,000 and up/ 15% yr.	Document management tracking, powerful mapping software, graphical user interface, pre-defined maps
EDI/Entry	DNS Worldwide	$995/ $350 yr.	Translator for entry, storage, and retrieval of documents
EDI/Developer		$1,495/ $350 yr.	Mapping software, creation of screen and EDI templates, table lookup, editing

Mapping and application interface software may not be a requirement for firms wanting to submit environmental reports electronically. It is possible that the information to be included in the report is manually captured and not available electronically. Another possibility is the

information will reside on various computer systems located throughout a plant, facility, or firm. Integration may not be practical until the information for report submission is collected in a central repository. Many factors affect the type, power, and flexibility needed for EDI software, and a thorough analysis of an organization's goals will determine the appropriate software.

2.3.2 Personnel Costs

Implementing EDI in an organization requires commitment from personnel within the organization. The recommended approach is to select a project team consisting of personnel from management, technical, and functional areas of the organization. If this approach is not practical, one person should be selected as an EDI project leader. A team or person to lead the effort is important to successfully implement EDI. In a large organization, this person would have a technical background, mostly likely from the information services department. For a smaller organization, a person who could devote the time necessary to address the project may be the best candidate. In addition to becoming the in-house expert on EDI, this person can provide training, answer user questions, and perform maintenance on the EDI system. Also, this individual could become a temporary training person for employees and cover the theory and components of EDI, the basics of EDI implementation, and the anticipated value which will be gained from EDI use.

The cost for an EDI project team can be estimated by using an organization's human resources statistics or statistics from consulting firms who provide the expertise during the implementation. The cost will depend on the size of organization, size of the project team, and the amount of current in-house expertise in EDI.

2.3.3 Education and Training Costs

Education and training costs are associated with classes and material required to educate personnel and support implementation efforts. These costs will depend on the training that is required and the resources that are used. Problems with EDI implementation are related more often to system use than to the hardware and software being used. People need to become comfortable with a new system, and education provides a less intimidating and more productive method for achieving this goal. In-house sources or outside training organizations can supply this training.

Information from outside sources such as VANs, trade shows, conferences, and published books and articles can be used to develop in-house training. The advantage of in-house training is the ability to tailor it

to the specific needs of an organization. However, a disadvantage of in-house training is the possibility of limited knowledge by the trainer as compared to an EDI expert.

External EDI training is usually presented by experts in the EDI field. Sources of this training include VANs, EDI consultants, software vendors, and EDI training organizations. In many instances, external training is conducted within your facility which eliminates travel expenses. In addition, free training may be available from certain resources such as the ECRC Program. This training would not be VAN or EDI software specific. Based on *CTC* research, the representative training costs are illustrated in Table 3. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 3. Representative Training Costs

Type of Training	Duration	Cost/Person	Comments
DOS EDI product	3 hours	$299	Introduction to EDI, basic product navigation
Government only EDI product	6 hours	$299	Introduction to EDI, basic product navigation, government procurement specific
Windows EDI product	3 hours	$199	Introduction to EDI, basic product navigation
Mapping; generic overview	3 hours	$395	Introduction to mapping, ANSI X12 Standard training
Mapping Product	6 hours	$695	Introduction to mapping, ANSI X12 Standards training, product use
EDI integration issues	3 hours	$199	General overview/training on dealing with integrating EDI with internal computer systems.
On site training	Full day sessions	$1,500/day + expenses	Any desired EDI topic; can be tailored to your organization

2.3.4 Communication Costs

Communication costs are costs normally charged by private third party networks call VANs. Although communication links can be a dial-up or a leased line directly to a trading partner, VANs are the method typically used to send and receive EDI transactions. In addition to the basic services provided by a VAN, they also provide backup and recovery services, compliance checking, and translation between differing standards or versions of standards. Basic VAN costs are an initiation fee, monthly or annual mailbox fees, access charges, and per transmission charges. Although the rates vary from VAN to VAN depending on the type and level of service, typical charges are:

- Initial fees; $200 - $300
- Monthly fees; $50 - $100
- Access fees; per call, per minute or toll free/local access numbers
- Transaction/transmission fees; $.10 - $.50 per kilo-character depending on time and volume of transmission; some VANs offer flat pricing per month.

Discussed below are examples of VAN products identified by *CTC*. This list is by no means comprehensive, nor may it reflect the most current prices or advances in this technology" (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 4. Representative VAN Charges (as of April 1997)

VAN	Initial Fee	Monthly Fee	Transmission Fees	Access Charge	Monthly Min.
AT&T	$150	$9 + $150 annual fee	.17/ 1000 characters + .20/ interchange	Not applicable	$30
Datamatix	$645	$55 $110 $220 $330	.25/ document .25/ document < 600 .25/ document < 2,000 .25/ document < 5,000	Not applicable	Not applicable
Harbinger	$645 (includes software)	$50 $200 $300	.25/ document .25/ document < 2,500 .25/ document < 5,000	Not applicable	$50
MCI	Not applicable	$25-$110	.20/ 1000 characters	Not applicable	$25
Softshare	$175	$60 or $480/year	.15/ document .25/ non-EDI document	Not applicable	Not applicable

2.3.5 Intangible Costs

There are also intangible costs associated with implementing EDI. EDI can significantly reshape or necessitate a redesign of the organizational structure and work processes. These changes create behavioral and organizational transformations which incur costs. Initially, productivity may decrease until personnel become accustomed to the EDI system. In addition, the system may need to be adjusted to interact efficiently with existing internal business processes. These costs are not measurable, but as the organization becomes familiar with EDI, the cost will be reduced.

2.4 Benefits of Electronic Commerce and EDI

EDI costs are much easier to quantify than EDI benefits. Some savings are obvious, such as reduced personnel expense for data re-entry, paper and postage

savings, and shortened receivable cycles. Other benefits, such as improved productivity, are not as easily captured. EDI benefits should be separated into different categories that include personnel savings, saving on supplies and postage, inventory savings, time benefits, and information processing cost savings. Advantages that are not easily factored into a cost/benefit ratio include closer customer and vendor relations, improved internal operations, and a competitive advantage in the market. These benefits should be considered even though a dollar value may not be assigned to them. After a company has implemented EDI, cost/benefit ratios can be calculated as new transaction sets are considered for introduction.

Another way to maximize the benefit of implementing EDI is by consolidating it with other technologies and business initiatives. Some of these business initiatives and strategies include Business Process Re-engineering (BPR), Information Technology (IT) insertion, Just-in-Time (JIT) inventory management, Evaluated Receipts Settlement (ERS), Continuous Acquisition and Life-cycle Support (CALS), and Vendor Managed Inventory (VMI). EDI can increase the efficiency of your company, but it must be implemented carefully, and with advance planning, so business processes are not adversely affected.

2.4.1 Volume of Transactions

The primary factor in determining the net balance of costs and benefits of electronic commerce is the volume or intensity of transactions. Where levels of transactions are low, electronic commerce is attainable but not economically justifiable, because the operational cost savings will not recover the initial investment in a timely manner. Therefore, the benefits of electronic commerce are biased toward large organizations involved in information-intensive trading relationships having high transaction volumes. Consequently, many small organizations adopt electronic commerce because of pressure from large trading partners attempting to increase their volume.

As new members join electronic trading communities, the number of electronic transactions will rise for existing members, making electronic commerce more cost effective. However, it is recognized that there is a "critical mass" or size of community where benefits exceed costs, and below that level, the cost exceeds the benefits. Electronic trading communities often do business below a cost-effective level, but justify these transactions in anticipation of continued growth.

2.4.2 Integration of Electronic Commerce with Internal Systems

The second factor in determining the net cost impact of electronic commerce is the level of integration of electronic document interchange with internal systems. Many organizations are nominally electronic commerce users, but either manually re-key electronically received data or use crude human mediated file transfers between the electronic commerce gateway and their internal systems. For example, detailed stock and shipping information received from retailers is sometimes printed out rather than integrated with suppliers' production planning systems. Organizations frequently postpone fully integrating electronic commerce because of the cost of modifying existing systems. It is postponed until the systems are due for replacement. This eliminates a significant re-engineering effort for a legacy system, but delays the full benefits of an electronic commerce implementation. This is often evident in the banking industry where bank customers are unwilling to embark on expensive modifications to existing financial systems, but will justify incorporating electronic commerce into new systems.

2.4.3 Elimination of Parallel Systems

The third factor is the elimination of the need for parallel electronic commerce and paper-based systems. Even when electronic commerce offers cost savings, maintenance of a parallel paper-based system reduces the net benefits of electronic commerce. If confidence in the electronic system is low, this may lead to continuing a parallel or backup system. In addition, many business partners are not yet willing to convert to an electronic system, prolonging the need for a legacy paper or electronic system.

This cost driver leads dominant electronic commerce traders to exert considerable pressure on partners who prefer to trade on paper to switch to electronic commerce, making it a requirement. Also, it is essential to make electronic commerce more attractive in isolated, well-defined communities where the level of trade outside the community is small.

2.4.4 Electronic Commerce Relationship to Process Re-engineering

As previously implied, applying a technical solution to a problem area will not necessarily provide a great benefit. A re-engineering of the process, system, or procedure, combined with technology insertion, will achieve the maximum gain in electronic commerce implementation. Organizations frequently implement electronic commerce solutions, but do not obtain process improvement, or in some cases, degrade the process. This is particularly true in small organizations where an installation of a

stand alone EDI system has been installed, requiring duplicate key entry for sending and receiving electronic documents.
Process re-engineering is using the power of modern information technology to redesign business processes in order to achieve dramatic improvements in performance. The goals of re-engineering are to:

- Reduce costs
- Improve cycle times
- Improve quality, and
- Improve productivity.

These goals are essentially the same as the goals of implementing electronic commerce technologies thus emphasizing the importance of using both.

2.4.5 One Method of Calculating Cost, Benefits, and Pay Back

One method of calculating cost, benefits, and pay back developed and published by the EDI World Institute considers initial investments, annual or recurring costs, and financial benefits; it then calculates an estimated pay back period for an EDI initiative. However, this method relies on an estimated annual return for intangible benefits to establish the pay back period. Figure 1 illustrates this approach.

Initial Investment on a PC platform

Investment	Approximate Cost
Computer/modem	$1,500 - $3,000
EDI software	$400 - $10,000
VAN start-up fees	$0 - $300
Training of personnel	2 days per person
EDI Documentation (if required)	$50 - $200
Consultant fee (if required)	5 - 10 days
Legal fees (if required)	$200 - $500
Integration of EDI	Variable
Total Initial Investment	

Annual On-going Expenses

Expense	Approximate Cost
Telephone line (if applicable)	$0 - $100
VAN monthly fee	$0 - $100
Transaction costs (volume dependent)	$.20 - $2.00/tran
Software maintenance	$100 - $600
Staff Support Costs	1/2 - 1 day/week
Training Fees	1 day per person
Trading Partner Recruitment	Variable
Total Annual Costs	

Annual Financial Benefits

Benefit	Annual Estimate
Increase of profit from sales	
Inventory reduction (factor in cost of maintaining raw material and finished product inventories)	
Staff reduction savings	
Miscellaneous expenses (postage, paper, forms printing, document storage, etc.)	
Total Annual Financial Benefits	

Payback Period Calculation

Net Annual Financial Benefits =
Total Annual Financial Benefits - Annual On-going Costs

Payback Period =
Total Initial Investments / Net Annual Financial Benefits

Figure 1. Calculating an EDI Implementation Pay Back Period

As noted earlier, if EDI is not integrated with in-house business and manufacturing systems, an increase in costs, rather than a reduction, may occur. In addition, annual benefits are progressive, increasing yearly as volume and additional transactions are converted to EDI. Therefore, the pay back period will likely be shorter than calculated in Figure 1 if the volume increases.

2.4.6 Examples of Benefits/Cost Savings Achieved

Table 5 provides a list of calculated and estimated benefits for various government offices and private organizations implementing EDI. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 5. EDI Cost Savings and Benefits

Organization	Calculated or Estimated Savings
Pacific Telesis (PACTEL)	Cost per transaction from $78.00 to $0.48
Texas Instruments (TI)	Average costs to process a purchase order from $49.00 to $4.70
R.J. Reynolds	99.5% reduction in cost of purchase orders
J.C. Penny	Over $1 million saved in postage costs annually
K-Mart	84% reduction from the cost of a manual purchase order to that of an EDI purchase order
SuperValu	Savings $6,000 per day in purchase orders and receiving invoice reconciliation costs
Health Industry Business Communications Council (HIBCC)	Purchase orders cost hospitals app. $40 to process (if that purchase order is sent using a vendor's electronic system, hospitals spend $30.40). EDI reduces cost to $11.20/purchase order
Long Island Medical Center	Inventory reduced by 25 percent over 2 year period
Bank of Chicago	Savings between $3.75 and $6.50 per document
Big Four U.S. Automobile Producers	Saving at $200 on each car produced
The Automobile Industry Action Group	Costs of processing purchase orders at $50.00-$75.00 reduced to $12.00
Veteran's Administration	Cost per invoice from $3.48 to $1.55; net savings of $12 million discounted over 5 years. Cost per Government Bill of Lading (GBLs) from $10.07 to $4.52 each
Department of Defense (DOD)	In its business case for electronic commerce, $1.2 billion in saving by automating 16 most-used forms over a 10 year period.
Defense Logistics Agency (DLA) Defense General Supply Center	$24.5 millions in savings with its Paperless Order Processing System (POPS); eliminated paperwork and reduced inventory and depot costs
Department of Commerce	99% reduction in paper processed by the Bureau of Export Administration in the issuance of export licenses

Three industries that have documented benefits from EDI are the automotive, electronics, and grocery industries. In addition to $200 per car cost savings cited above, the order time for a new car has been reduced from 13 to 7 days. These savings are substantial from the viewpoint of the manufacturer. EDI enables them to provide better quality goods at reduced costs in a significantly reduced amount of time. As EDI is implemented on a much larger scale, these savings will trickle down to the consumer.

Another example is an electronics industry study that shows the processing cost of one purchase order is $50 per paper page. By

exchanging purchase orders electronically through EDI, the cost is reduced to $4 per electronic page.

The grocery industry was an initial leader in EDI implementation on an industry-wide basis. Because grocery chains distribute large amounts of daily purchases, EDI is particularly conducive to the industry's needs. The Arthur D. Little study found that 50 percent of the grocery industry uses EDI for $300 million in total benefits. With increased EDI implementation, the potential savings in the grocery industry are projected at over $600 million annually.

As these examples show, the potential for cost savings is a significant reason for implementing EDI. There are numerous cross-industry examples of substantial cost savings due to EDI which have resulted in increased competitiveness and profitability. However, note that most of the examples are large organizations with a high volume of EDI activity. In addition, a significant industry or company wide re-engineering effort contributed to the savings. This reinforces the belief that volume of transactions and process re-engineering play significant roles in the benefits received for electronic commerce initiatives.

2.5 Case Studies

Parallels can be drawn between EDI implementation for common business activities and EDI implementation for environmental reporting. Qualitative analysis of case studies provide valuable insight into the economic motivations of electronic commerce users. Case studies indicate that electronic commerce is mostly used for operational cost savings by reducing clerical processing of transactions in wider supply chain management policies, such as quick response or just-in-time supply. Case studies also show that these benefits are unequally distributed between electronic commerce partners. These inequalities are explained by the volume of transactions, the integration of electronic commerce with internal systems, the elimination of parallel systems, and process re-engineering. These four factors are key areas which affect EDI implementation in any environment.

As the following case studies indicate, numerous cross-industry examples exist of substantial cost savings due to EDI. One estimate places cost reductions across all industries at between 5 and 6 percent of sales (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Case Study #1

A tobacco company performs nearly 100 percent of its purchasing through EDI. In the spring of 1993, the company completed 92 percent of its purchases electronically and notified their remaining suppliers that if they did not become EDI capable in 30 days, they would have to retrieve orders from a fax extension offered by a service bureau. This transition to an electronic purchasing system dramatically reduced costs and cycle time.

Prior to implementing EDI, the tobacco company operated in a near total paper environment. The tobacco company began using EDI at the request of a large grocery chain. After seeing the value of EDI, the company gradually decided to pro-actively integrate EDI into their purchasing and other applications. By 1992, 86 percent of all orders were placed via EDI to 560 major suppliers. However, nearly 1,500 suppliers resisted the move to EDI. In order to achieve the full benefits of EDI, the tobacco company decided to employ a service bureau to fax orders received electronically to non-EDI suppliers. The service bureau relationship involved the following steps:

- The tobacco company sends the orders electronically to a mailbox on their VAN
- The service bureau connects to the VAN mailbox regularly to retrieve orders and then translates and faxes the orders to the respective suppliers
- The suppliers fax back an acknowledgment of order receipt
- The service bureau forwards the acknowledgment in EDI form to the VAN where it is retrieved by the tobacco company.

The results of implementing EDI for this tobacco company have been remarkable. Purchasing costs have been reduced significantly from $75 per paper order to $0.93 per EDI order. EDI is saving the company more than $5 million annually in inventory costs.

Case Study #2

A software provider has capitalized on EDI technology using EDI for its own purchasing and for customer processing. This software provider had been functioning as a supplier to a large EDI capable company which drove their EDI implementation. Today, it functions as a hub that drives the implementation of EDI with its suppliers. Typically, a major customer demands that a supplier like this software provider develop an EDI capability in order to maintain or increase the customer's business. In 1986, the software provider dedicated a single PC to the receipt of proprietary order forms from a VAN for one major customer. They continued to add, customer by customer, until 1990, when it became clear that this piece meal approach was resulting in high costs and minimal benefits of EDI.

The software provider converted to the ANSI X12 Standard and began to integrate EDI into its order processing and accounting systems. Today, the company has the capability to receive purchase orders, acknowledge them with

return information, and send shipping notices, catalogs, and invoices electronically. The software provider now receives orders within hours, receives payment in days rather than weeks; and has been awarded several major, multi-million dollar contracts, primarily due to increased service as the result of EDI. Additionally, customer orders have increased from ten to as many as 200 a day without an increase in personnel to handle the additional work load. The software provider attributes these successes solely to their EDI capability.

Case Study #3

A grocery retailer exchanges a large number of documents with thousands of suppliers throughout the country and the world. In 1985, this grocery retailer moved to EDI, using a PC-based DOS EDI software program. The EDI program has experienced phenomenal growth since that time, growing at an unprecedented 40–50 percent volume annually. Approximately 90 percent of the company's grocery purchase orders are sent via EDI. The grocery retailer plans to have 100 percent of its purchase orders and invoices processed electronically.

This grocery retailer's Electronic Fund Transfer (EFT) program began in May 1993. Under the program, they now send the Payment Order/Remittance Advice (ANSI X12 transaction set 820) directly to their bank, which then transmits both the data and dollars to their trading partner's banks. By mid 1996, they had nearly 100 trading partners using EFT. The grocery retailer plans to significantly increase that number by the end of 1997.

Recognizing that all vendors are not created equal, this grocery retailer has taken innovative steps toward meeting the needs of vendors who are not yet EDI capable. The company provides assistance for trading partners through an EDI hotline, a stand alone PC-based solution, EDI to facsimile options, and trading partner implementation kits. This enables this grocery retailer to educate vendors and encourage them to move forward with EDI.

Case Study #4

Several years ago, an organization which had interests in home video, music retailing, interactive software, programming, production, and distribution, became a pioneer in the home video industry by adopting EDI technology. Since then, the firm has grown into a multi-billion dollar company with over 4,400 video and music stores worldwide. The company's success can be partly attributed to its EDI program, which handles over one million EDI transactions a month.

In order to maximize the investment placed into the EDI program, this organization's EDI team decided to implement the Invoice (ANSI X12 transaction set 810) transaction set first. The Invoice was identified as the transaction set that would derive the most benefits. Once the 810 transaction set was firmly incorporated into their business processes, the company implemented

the Purchase Order (850), Message Text (864), Payment/Remittance Advice (820), File Transfer (996), Application Advice (824), and Freight Details/Invoice (110, 210) transaction sets.

Today, the company electronically trades an average of one million transactions per month with over two hundred trading partners. This organization uses twelve ANSI X12 transaction sets that range from purchase orders to electronic payments. Additionally, they remain committed to the EDI process and electronic commerce, and envision a continued expansion of their EDI capability to the Consolidated Service/Invoice (811) and Credit/Debit Adjustments (812) transaction sets.

Case Study #5

In 1985, directives came from the chairperson of the board at a mass merchandiser to the information services department to design and develop the systems necessary to support electronic purchase orders and invoices. Their purchasing and accounts payable users became active later.

The mass merchandiser encouraged its vendors to implement EDI by sending a letter to the vendor community, signed by the vice president of merchandising, expressing their desire for the vendors to implement EDI. The second letter included the dates by which the vendor was expected to be EDI capable. The top 200 vendors measured by amount of business were given the choice of transmitting directly with the mass merchandiser or through a VAN.

Today, this mass merchandiser uses EDI to send 90 percent of its orders and receive 80 percent of its invoices. Approximately 100 trading partners continue to transact business directly with the mass merchandiser while the others have chosen to use a VAN. However, over 1,000 vendors are not yet using EDI and are proving to be difficult to convert. They are typically the low volume vendors to the mass merchandiser and are usually smaller companies with limited resources and technical capability. To reduce the manual processing of orders and invoices, this mass merchandiser uses an outside service bureau that converts EDI orders going to non-EDI vendors to a print format which is then faxed or sent via conventional mail services. The service bureau also converts incoming invoices from printed documents to EDI documents and transmits them to the mass merchandiser.

Health Care Business Case Analysis

In 1992 and 1993, the health care industry's Working Group for Electronic Data Interchange (WEDI) Technical Advisory Group (TAG) developed two reports which described and quantified EDI benefits for the health care system. Their efforts are one of the most comprehensive analyses performed to date to assess and document the value of EDI. These reports reflect how EDI can financially improve the paper-intensive environment that is associated with current health care policies.

For most industries, EDI is just the computer to computer exchange of business information in a standard format. In the health care system, this business exchange deals with financial or personal information. Both types of information are sensitive in nature and both require solid exchange platforms. Therefore, these reports can be very useful in deciding how EDI will influence an industry and will aid in providing baseline assessments on EDI implementation strategies.

Both of the formerly mentioned reports focused on the costs and savings associated with EDI implementation. However, the 1992 WEDI report, which estimates a gross administrative savings of $4 to $10 billion, only used five transaction sets in its analysis and was derived without data on providers' estimated savings. For this reason, the focus of this discussion will be on the 1993 report.

In 1993, the WEDI analysis was expanded to three additional features. First, total EDI implementation costs were derived from estimates examining the entire health care system. This feature includes significant investments for creation and upgrades of automation platforms. TAG estimated a range of costs required in implementing a fully capable EDI environment. Second, newly available data regarding provider savings was used. Finally, six additional transaction sets were included. From this report, data was available on implementation costs, administrative savings for core transactions, and additional transactions.

Implementation costs were estimated to range from $5.3 to $17.3 billion, a one-time total implementation cost across the entire industry. Savings through administrative core transactions and the additional six transactions were estimated to range from $8.3 to $19.7 billion and $4.6 to $6.3 billion, respectively. With these combined figures, this report estimates an annual gross administrative savings of $12.9 to $26.0 billion, based on ongoing savings and necessary investments to use EDI for each transaction. Additionally, the 1993 report estimates that core transactions increased from $4 to $10 billion in 1992 as compared to $8 to $20 billion in 1993.

Additional figures from the study show the breakdown of the estimated $12.9 to $26.0 billion annual gross administrative savings for providers, payers, and employers in the health care system. Providers are estimated to save from $9.1 to

$15.5 billion. Payers' gross administrative savings are projected to save from $1.8 to $6.4 billion, and employers' savings are estimated to be between $2.0 and $4.1 billion.

Over a six-year period with full EDI implementation across the industry, net savings could reach $42.3 billion, with a projected net savings of $26.1, $9.4, and $6.8 billion for providers, payers, and employers, respectively.

Most importantly, it is critical to determine where the savings come from and which transactions they include. The TAG initiative tackled this problem by outlining the transactions and quantifying the respective savings in all 11 transactions that are examined including enrollment, eligibility verification, claims submission, payment and remittance, claims inquiry, materials management, prescription ordering, test ordering/result reporting, coordination of benefits, referral and pre-authorization, and provider appointing/scheduling.

Table 6 below outlines the transactions, the information exchanged, the old method used, the savings involved and the EDI savings feature involved. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 6. WEDI Identified Health care Industry Savings

Transaction	Information Exchanged	Old Method	EDI Savings (employers, payers, & providers)	EDI Savings Feature
Enrollment	Personal Information	mail/paper	$2.1 to 4.32 billion/yr.	Streamlined through front-end EDI implementation
Eligibility verification	Eligibility, deductibles, or co-payments status	telephone	$252 to 480 million/yr.	Office staff labor costs in handling questions
Claims submission	Policy information	mail/paper	$2.3 to 5.33 billion/yr.	Streamlined through front-end EDI implementation
Payment and Remittance	Transfer of funds	mail/paper	$32 to 285 million/yr. + $1 billion for hospitals and practices	Streamlined through electronic funds transfer
Claims inquiry	Status of claim	mail/paper/ telephone	$100 to 202 million/yr.	Office staff labor costs in handling questions
Materials management	Ordering, acknowledgment, invoicing, and payment for supplies and equipment	mail/paper	$1.4 billion + $ 1.6 to 3.1 billion for hospitals and $3.2 to 4.8 billion for suppliers/yr.	Streamlined handling of resources
Prescription ordering	Ordering of prescription drugs	telephone/ paper	$664 million/yr.	Office staff labor costs and accuracy of information
Test ordering/ Result reporting	Information on specimen testing and results	mail/paper	$294 million/yr.	Streamlined exchange of testing paperwork
Coordination of benefits	Determination of financial claims responsibility	mail/paper	$477 to 657 million/yr.	Allows payers to electronically exchange claims in question
Referral and Pre-certification	Information on referral and pre-certification	mail/paper	$167 to 176 million/yr.	Allows for electronic exchange of referral information
Provider appointing/ Scheduling	Logistical information	mail/paper	$47 million/yr.	Automates scheduling and confirmation procedure

EDI has the potential to improve the health care industry by streamlining its activities, reducing administrative costs, and enhancing the quality of the services provided. As previously mentioned, gross savings is estimated by TAG to reach $13 to $26 billion per year, with a net savings of $42 billion by the year 2000. Much of these savings results from health care enterprises having the ability to properly allocate resources among administrative duties. Additionally, these

types of improvements can have a positive impact on the quality of health care received by all Americans.

For other industries, much can be learned from TAG's 1993 health care report. First, it offers the basic knowledge of where and why savings through EDI use are incurred and pinpoints savings features as it relates to each EDI transaction. Secondly, it demonstrates how an industry-wide EDI implementation can effect an industry and how the ripple-effect of savings to participants (providers, payers, and employers) occurs through the one-time capture and dissemination of information. Finally, it shows how EDI can act as a security control in processing information and reducing the possibility of fraud or error. This improves the quality of information and allows for the proper allocation of resources.

2.6 Relevance to EPA

The studies and statistics provide a solid business case for electronic commerce implementation in a variety of businesses, industries, and government programs and agencies. Statistics clearly show that dollar savings and improved information processing and flow are achieved using electronic commerce technologies, regardless of the size of the organization. Parallels can be drawn between these studies and statistics and the EPA's electronic reporting initiatives. Due to its size and the massive amount of information it processes, the EPA will obtain comparable benefits and savings to the large organizations cited previously. State and local environmental agency partners also will benefit but to a lesser degree than EPA because of less transaction volume.

However, the common problem faced by most organizations is getting trading partners to engage in electronic commerce initiatives. This problem is addressed by three methods; (1) electronic commerce mandates, (2) providing trading partners electronic commerce implementation assistance, and (3) developing low-cost, user-friendly solutions that enable trading partners to participate in electronic commerce initiatives. At this point, the EPA is not requiring electronic reporting and needs to stress methods 2 and 3 above. Providing trading partner assistance as in this present initiative and creating alternative electronic commerce mechanisms will enable EPA to attain increased electronic reporting benefits in a quicker time frame.

3.0 ALTERNATIVES TO CONVENTIONAL EDI

As technology progresses, mechanisms to supplement conventional methods of EDI are being developed. Most methods involve the use of Internet-based strategies including standards-based EDI transmitted via the Internet to bypass a VAN. Web-based forms will capture and transmit information via the Internet, including the exchange of high volume technical data files. Another approach being explored is the use of eXtensible Markup Language (XML) to facilitate EDI via the Internet. XML is a simplified version of Standard Generalized Markup Language (SGML) and touted as the next technological advance in Web page creation. It is not intended as a replacement for Hypertext Markup Language (HTML), but as a supplement. Some of these techniques are particularly suitable for small businesses which often find that implementing conventional EDI is not practical or affordable. Currently, approximately 2% of businesses have EDI capabilities, with the inception of XML/EDI this number would increase to approximately 70%-80%.

Organizations are moving to the Internet for electronic commerce solutions for two basic reasons: 1) the Internet is generally less expensive than other media for transmitting information and 2) organizations wish to market and sell their products and services to potential customers on the Web at work or at home. The rapid increase in business, industrial, and government agency deployment of Internet-based information, advertising, and marketing is not driven so much by public demand but by competition, media exposure, and low entrance expenses. A Gartner Group study was conducted in 1995 showing typical startup and ongoing costs to establish and maintain a Web presence for an organization. (The Gartner Study results, shown below, should be used only as an approximation of the relative costs of web site start-up)

Table 7. Typical Costs to Establish a Web Site

Item	Start-up Costs			Annual Ongoing Costs		
	Low	Mean	High	Low	Mean	High
Web Server Hardware	15,000	25,000	50,000	-	-	-
Web Server Software	15,000	25,000	50,000	-	-	-
Firewall	10,000	12,000	25,000	-	-	-
Web Content Development	15,000	25,000	50,000	-	-	-
Telecom Links (T1)	10,000	12,000	15,000	10,000	12,000	15,000
Staffing	30,000	45,000	50,000	30,000	45,000	50,000
Hardware Maintenance	2,000	5,000	15,000	2,000	5,000	15,000
Software Maintenance	2,000	5,000	10,000	2,000	5,000	10,000
Content Maintenance	5,000	10,000	20,000	5,000	10,000	20,000
Total Cost	104,000	164,000	285,000	49,000	77,000	110,000

According to the Gartner Group study, costs in hardware, software, and communications are likely to drop 20 to 30 percent per year through 1999. This trend will allow large organizations to establish a Web presence more economically and also open the door for smaller organizations to establish Web sites.

3.1 EDI and the Internet

Many electronic commerce analysts believe that EDI and the Internet are a natural match, particularly for small firms which cannot afford and do not possess the technical expertise to implement EDI. Its wide reach, availability, and low cost make it an attractive business mechanism. In addition, Web-based solutions provide alternatives in instances where EDI is not practical. Forms-based entry on a Web browser with EDI translation in the background enable small organizations to participate in large trading partner EDI initiatives. For example, a small company that needs to interact with a large company, but is unable to support a traditional EDI implementation, can utilize an EDI service bureau. A service bureau is an outside vendor which provides EDI capabilities via the Internet or other alternate method for a fee. Due to market pressure, several VANs currently offer this type of service while many more are developing this capability. According to the Forrester Group, spending on Internet software will explode from $127 million in 1995 to $8.9 billion in 1999, and on-line commerce between companies and consumers will leap from $500 million today to $6.5 billion by the year 2000.

Web-based solutions are particularly evident in federal government procurement where several VANs are providing access to the Federal Acquisition Computer Network (FACNET) with Web-based form front ends. Generally, a company can subscribe to this type of service for less than $100 per month. A Request for Quote (RFQ) profile is set up corresponding to the company's type of business, product line, and location. Various criteria are used including Federal Supply Groups and Codes (FSG, FSC), locations of buying facilities, and keyword searches. The firm is notified of bid opportunities via e-mail or the Web site. The RFQ is accessed, analyzed, and potentially bid on via the Web form. The service will turnaround a response to the RFQ with minimal additional key entry on the part of the subscriber. Notification of a Purchase Order (PO) or a Contract Award is also accomplished via e-mail or the Web site. In addition, many services provide RFQ search capability if a firm desires to look for opportunities to expand their customer base to different geographic areas or products.

According to *CTC* research the main problem areas, which exist with Web-based solution, arise from in-operability due to browser interface. This interface may be skewed or non-existent if a web page is not designed to accommodate the different browsers that exist in the market today. The different browsers in today's virtual world come from many different manufacturers, and are further complicated due to user preference by version. Designing a simplistic web site, or multiple web sites, to accommodate these different browsers ensures the functionality of Web-based solution.

3.1.1 Internet EDI for Large Organizations

Slightly larger companies that may have internal EDI capabilities as well as the option of using a VAN also take advantage of the Internet. These firms are using newly available products that allow them to implement Internet-based EDI without the aid of an outside vendor or a VAN connection. Several major corporations that have high-volume EDI needs and are capable of traditional EDI are opting for linked intranets. This type of solution allows various implementations of EDI, such as those through the Internet and VANs, to work simultaneously.

The attraction of EDI over the Internet for firms having high volume EDI is cost savings. Conventional EDI via a VAN is expensive, with users paying VANs twice, first for rental fees for electronic mailboxes and, second, a charge for each message frequently based on the message size. A rough estimate, depending on the VAN used, is about 25 cents a page. An organization handling 125,000 messages a month can pay monthly charges of $50,000 to $100,000 depending on the VAN and the amount of traffic during prime transmission times. Transmitting in off-peak hours can save a firm 20 percent or more. However, the same number of messages sent via the Internet would cost significantly less, perhaps saving as much as 50 to 75 percent. In addition, transmitting EDI over the Internet allows companies use other electronic commerce tools, including multimedia capabilities offered through the World Wide Web and interactive EDI. Interactive EDI allows trading partners to interact in real time as opposed to the traditional EDI model of time-delayed, batch-style interactions. For example, EDI in healthcare has lead to real time transactions of claims/ payment advice, patient information requests, and patient eligibility inquiries.

EDI over the Internet can also help large companies extend their reach by working both horizontally and vertically. Large firms can connect to smaller trading partners that do not have EDI capabilities but use the Internet. Their vertical reach is extended by using new, innovative electronic commerce technologies, such as sending design specifications and artwork directly to trading partners.

3.1.2 Internet EDI for Small Organizations

Even with today's technological advances, EDI, for some companies, is not appropriate in any medium. But for many SMEs, the only return on investment from EDI is through an Internet-based solution. For others, like a large auto manufacturer which transmits a large amount of data to suppliers and customers, EDI on a VAN is the only real choice, because cost does not preclude it. The Internet, however, is a viable option for smaller companies to gain access to EDI because it provides communications capabilities at a far lower price. The trade-off is not having the reliability or security of a VAN.

Other efforts which will enable small organizations to leverage the Internet for EDI are also being developed. One of these initiatives is to combine EDI and e-mail on a large scale. The Internet Engineering Task Force (IETF) is actively pursuing standards for encapsulating EDI documents within the MIME protocol. In addition, Web pages can be set up to contain EDI documents while disguising their complexity from the user. The user, while not truly EDI capable, complies with an EDI mandate with a VAN accomplishing the EDI translation behind the scenes.

3.2 Internet-Based EDI Initiatives

Many small and large organizations, both in the government and private sectors, are using the Internet to supplement their electronic commerce strategy. Many Web-based initiatives focus on making electronic commerce attainable for SMEs and other trading partners. Several examples of Web-enabled EDI follow, including insight on decisions to use the Internet as a basis for electronic commerce solutions and products.

3.2.1 Examples of Internet EDI Approaches, Initiatives, and Products

The following section outlines some of the more recent Internet EDI approaches. This is not a comprehensive list of these approaches and may not reflect the most current technological advances. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Texas Instruments

Texas Instruments' semiconductor group, located in Austin, Texas, processes nearly 180,000 EDI messages a month. Most of these electronic documents travel through seven VANs, including IBM's Advantis and General Electric Information Services (GEIS). However, to increase transmission speed, reach out to new markets, and cut costs, Texas Instruments is looking at moving much of this document exchange to an Internet-based transmission strategy. Texas Instruments is part of a growing number of large corporations, who, when recently surveyed by Forrester Research Inc. in Cambridge, MA, say they plan to run EDI over the Internet.

The semiconductor group is about to implement this capability in a production environment with its first trading partner. In a recently completed pilot project, Texas Instruments documented a significant savings by transmitting EDI messages over the Internet. Another benefit gained by using the Internet is a significant reduction in response time. During the pilot, responses came back in seven to ten minutes. With a VAN, Texas Instruments typically waits several hours for a response primarily because EDI messages are sent in batches at night in order to hold down costs.

National Aeronautics and Space Administration

Another innovative approach is being used at the National Aeronautics and Space Administration (NASA) Goddard Space Flight Center in Greenbelt, Maryland. A project called Scientific and Engineering Workstation Procurement for the Business Operations and Workstations Laboratory (SEWP BOWL). SEWP BOWL consisted of 16 contracts that offered a vast selection of advanced technology UNIX and NT workstations as well as peripherals, network equipment, and other services. SEWP BOWL then offered these products to all Federal Agencies and their contractors, through EDI, at the lowest surcharge.

Goddard recognized that many SMEs cannot afford to implement EDI and compared VAN charges to Internet access charges. The Internet was a clear choice for small suppliers due to lower costs. A system was developed by which vendors could send and receive EDI documents via e-mail using Premenos' Templar product. In order to provide EDI capabilities to its own staff and those of the other federal agencies with which it does business, Goddard developed a paperless order generator, a laptop PC bundled with an EDI translator based on technology from TSI International. Using this system, Goddard's staff members can package their purchase orders as EDI documents without learning EDI. Procurement was streamlined and made faster and less expensive.

Although an order still needs to go through normal accounting procedures, once it becomes a purchase order, it takes two days to complete rather than two weeks.

St. Paul Software

St. Paul Software, a leading EDI translation software vendor, has deployed a solution called WebEC for business to business transmission of transactions via the Internet. Using various software applications, non-EDI capable organizations can use a standard Web browser as an interface for sending and receiving standard EDI business documents. Internet-enabled HTML document screens or business to business catalogs provide the source for electronic transmissions to the St. Paul Software Service Bureau. The service bureau then translates the data from HTML format to standard EDI format. The transaction is sent via a VAN or the Internet to the trading partner where it can be mapped from the EDI format into the format required by the receiver's computer application software. This is similar to several of the services offered by VANs and provides small organizations with an option to conventional EDI without requiring the services of a VAN.

InsWeb

Large companies, typically having conventional EDI capabilities, can also leverage the Internet for electronic commerce benefits. InsWeb, located in San Mateo, California, is a relatively new company that sells insurance via the Internet. Consumers needing an insurance policy can access InsWeb's Web site and browse policy offerings from over 35 companies. Forms can be completed to purchase a policy, InsWeb converts the information to an EDI document, and then forwards the documents to the appropriate insurance company. However, despite the link to the consumer taking place via the Internet, the link from InsWeb to the insurance companies does not. The link to the insurance companies is through a conventional VAN service due to the insurance companies' preference. The insurance companies prefer to have intranet systems within their own offices but to not have a direct Internet link to consumers. However, they view InsWeb as a trusted system in which InsWeb basically functions as an extranet gateway to the Internet. The insurance companies get the benefits of Internet-based EDI and VANs at the same time and do not need to address the security problems or maintain a Web-based electronic commerce solution.

Monitor Medical

Monitor Medical of Winston-Salem, N.C., is a distributor of medical and critical-care supplies, with products ranging from commodity items such as syringes, to specialty items like ventilators. Monitor utilizes an information systems consulting company for much of its information processing requirements and uses EDI to link to its prime customers and suppliers. Hospitals, nursing homes, and their manufacturing supplier base can place orders, pay bills, and receive payments via EDI. However, this EDI solution is VAN-based and is not accomplished through the Internet.

In order to provide links to its smaller customers and suppliers and to provide a user-friendly means of tracking and managing orders to larger ones, Monitor implemented a non-EDI electronic commerce system on the Web. This system utilizes WebSpeed from Progress Software and provides timely information to customers, including order verification and shipping information. Customer service representatives are bypassed for a majority of customer inquiries. Depending on an organization's needs, conventional EDI, combined with Web technologies, provide the best, most cost-effective solution for electronic commerce requirements.

MPACT Immedia

MPACT Immedia provides comprehensive electronic commerce software and transaction network services to many of the world's leading corporations. The company's products are designed to help organizations move from paper-based invoices, payments, and correspondence to electronic transactions.

MPACT recently released an Internet purchasing and payment system called BuyWay. The service is the first of its kind because it supports a totally secure purchasing environment for both credit cards and bank-account electronic fund transfers. When buyers enter the merchandising site and choose the products they want, BuyWay takes care of the rest. The system securely verifies credit card transactions with any bank in North America, transmits the order to the supplier via EDI or any other electronic format, and confirms the shipment of the product to the customer.

BuyWay will also incorporate newer security standards, including the Secure Electronic Transaction (SET) protocol, currently being developed by MasterCard and Visa International.

CyberPath

CyberPath has developed a software application solution called TranSure. This package assists small businesses by enabling them to take advantage of the promises of electronic commerce using familiar Windows environments and inexpensive personal computer systems and networks. TranSure software is scaleable from a single inexpensive personal computer to a complete multiple-server LAN-based system. It combines powerful Internet security with the ability to work equally well on individual workstations and networks. While it is designed to be used over the Internet, it is suitable for any type of public or private transmission, yet provides the functionality of traditional mainframe-based EDI systems.

It is marketed as one of the first business-to-business electronic commerce solutions designed from the ground up to take advantage of inexpensive PC hardware, Windows operating environments, and the Internet. This makes TranSure one of the most cost-effective application systems available for any size company, from individual small business transactions to Fortune-500 corporate volumes. It provides a level of transaction security that works well in both traditional VAN environments and on the Internet.

Part of the TranSure approach to Internet-based electronic commerce involves an innovative new concept known as the Commerce Center. This is a third party "trusted agent" that houses a special TranSure server to provide many of the services of a traditional VAN, but uses the Internet instead of a private network. In essence, the Commerce Center acts as a "virtual VAN" to enable reliable and secure Internet EDI transactions. Commerce Center services include:

- User authentication: supplying electronic or digital certificates that verify each electronic trading partner
- Transaction verification and non-repudiation: independently making sure that all messages that are sent by one party are received by the other
- Security key generation and distribution: sending electronic encryption keys as requested by trading partners to encode and decode transaction messages
- Independent logging and optional archiving of electronic commerce transactions: keeping an independent audit trail of all transactions between trading partners
- Trading partner management: keeping important information about EDI trading partners, such as contact names, e-mail addresses, and billing information, and assisting in bringing on new trading partners
- Management services such as transaction reconciliation

- Electronic funds transfer support in the near future.

Usually, the Commerce Center server will reside at a bank or financial institution. CyberPath is currently in the process of setting up business relationships with numerous banks that will house Commerce Centers. In the near future, the Commerce Centers will also enable secure electronic funds transfer between TranSure trading partners as an extended EDI service.

CyberPath's product, TransSure, displays the ability to satisfy the criteria mentioned earlier in this section regarding cost, complexity, and security by providing a low-cost, scaleable and secure method to transmit EDI documents.

Dynamic Web Transaction Systems, Inc.

Another innovative approach is provided by DynamicWeb Transaction Systems, Inc. They offer Internet software and services through a revised electronic commerce model and provide the ability to integrate into a business' legacy systems. Their EDIxchange product is another solution which can help bridge EDI and the Internet and is currently being used by EDI-enabled retailers and suppliers. It allows non-EDI trading partners to send and receive EDI documents seamlessly by incorporating Internet transmission capability with the ability to integrate transmissions with internal business applications.

DynamicWeb's EDIbridgeNET service is a bi-directional EDI mapping, translation and routing service that seamlessly and securely moves EDI documents between the VANs, the Internet, and clients. They have also addressed security issues by adhering to industry standards for Internet access, protocol, and security. This allows their customers to safely and reliably transmit business documents over the Internet. This solution will permit organizations leverage Internet transmission advantages and provide integration capability to control costs and maximize the benefits associated with EDI implementation.

Hewlett-Packard

Hewlett-Packard is a large supplier of computer hardware and software and has implemented EDI with over one thousand trading partners. Their monthly transaction set volume is nearing one million transactions per month. However, their EDI strategy not only encompasses conventional methods such as VANs and point to point dedicated lines, but also includes using the Internet as a transmission media. Currently, almost 50 percent of their EDI transaction volume is via the Internet, thereby replacing the VAN and related transmission charges. In effect, Hewlett-

Packard is using the Internet to accomplish data transport and delivery, but not to provide any of the myriad of services VANs also furnish.

Atlas Products International

Atlas Products International (API) is addressing security issues for companies doing EDI over the Internet. API has identified five threats to EDI transfers between trading partners using this medium of data transmission.

- Loss: The data may be lost by the network or the system through which it is transferred.
- Modification: The data may be modified by a third party before being received by the true recipient (loss of data integrity).
- Reading: Sensitive data could be read by a third party.
- Repudiation: The recipient may claim never to have received a message or the sender may deny sending a particular message.
- Masquerade: A third party may act as a valid trading partner in order to send a recipient inaccurate information.

It is important to remember that these security issues are just as valid for trading using paper or VANs. According to API, the reason that the risk is greater over the Internet is not that the threats are different or greater, but that the vulnerability is dramatically increased. The Internet offers inexpensive, worldwide communications but because it has no overall owner, it sometimes lacks credibility in the commercial sector. No ownership means no guarantees, so the Internet can be perceived as too risky for business transactions.

API's product, Atlas EDI, is an attempt to address security concerns and uses the Multi-purpose Internet Mail Extensions (MIME) standard. The MIME standard has the ability to send almost any form of data encoded in an Internet mail message. It has also improved the integrity of the Internet mail transfer by providing standard methods of encoding a message into characters known to be transferred correctly by all routers and forwarders used on the Internet. Atlas EDI is one product which incorporates this technology and uses it to supply secure EDI over the Internet.

3.2.2 VAN and EDI Software Vendor Web Services

As outlined above, the products and services which leverage the Internet for EDI are gaining in popularity and use. VANs and EDI software vendors are embracing the Web to retain their current business base and expand their range of services. In an effort to take advantage of this Internet revolution, many VANs have developed new products and taken

on pilot projects to develop software that can accomplish EDI over the Internet.

GE Information Services (GEIS), one of the pioneers of conventional EDI, is now offering Web accessible translation services. While many Web-based EDI initiatives are focused on federal government procurement, GEIS's solution is intended to provide EDI-based electronic commerce to buyers and sellers in the private sector. Users tend to be low to medium technology firms without large information service organizations. These firms see conventional EDI solutions as too expensive, complex, and proprietary. Other EDI service bureaus are being announced frequently. These types of services may be the future for the vast majority of EDI transactions now on the horizon. Some industry analysts expect EDI clearinghouses similar to current check clearinghouses. These services may largely define EDI for SMEs in the future.

However, the clearinghouse concept will impose a certain level of overhead on every transaction. Therefore, the more EDI documents sent or received, the more expensive it may become to use. High volume EDI participants may find that Web-based EDI services lose their effectiveness and appeal. High volume EDI is subjective with some experts suggesting 40 to 50 transactions is high volume, while others consider the high volume threshold to be several hundred to one thousand EDI transactions per month.

In spite of this higher volume category caveat, the Internet is still an option. Several companies, including GEIS, Harbinger EDI Services, and Sterling Commerce, are now offering products that allow the user to implement Internet-based EDI. A description of some VAN products and services are provided in the following sections.

Premenos

Premenos Corporation is the software vendor most often mentioned for laying the groundwork for EDI over the Internet. In 1995, they released Templar, which enabled EDI transactions over insecure lines, such as the Internet, while providing much of the security associated with traditional EDI. Currently, many problems still exist in its application. However, Premenos claims that standards used in its development and ongoing re-engineering will allow it to engage with other products when they come to the market.

In addition, Premenos has aligned itself with vendor and translator companies such as Computer Associates and Verisign. These organizations have customized their products to operate with Templar, and

in the process, added security to the EDI over the Internet transactions, all of which helps build the infrastructure for such future dealings.

Premenos also offers a Web-based electronic commerce solution in WebDox. WebDox allows organizations to connect to trading partners reluctant to use EDI via the Internet and the Web. It allows for organizations to exchange both document and non-document information. WebDox uses a two-component electronic commerce trading structure. It uses a central location at the server, WebDox Central, for the dispersion of information, as well as a remote Web-based module at each individual site called, WebDox Remote.

Harbinger

One of the products which has recently come into the market is Harbinger Express offered by Harbinger as one of its Internet-based EDI technologies. Designed to provide secure EDI transactions over insecure lines, Harbinger Express incorporates electronic commerce on the Web by enabling the translation between HTML and standard EDI formats. It allows for response to business documentation through ordinary Web browsers and supports many of the common EDI forms.

A second product, TrustedLink Guardian, was offered by Harbinger in 1995 and is designed to be more conducive to traditional EDI. It enables organizations to send secure EDI transactions over the Internet using TCP/IP connections. By incorporating Nortel's Entrust, one of the most popular encryption tools on the market, it allows users to gain access to public keys in a central location. In addition, it provides support to both PEM and S/MIME encryption methods.

Currently, Harbinger and Premenos are working together to assure that their Internet-based EDI products accommodate one another.

GE Information Services (GEIS)

An additional option for EDI is GEIS's GE TradeWeb. Developed in 1996, and designed to accommodate smaller organizations, GE TradeWeb allows users to conduct EDI transactions in minutes by supplying EDI ready-to-use forms on the Web. GE TradeWeb's library has the most commonly used business documents, both generic and customized in nature, including purchase orders, invoices, and acknowledgments. All that is needed to exchange business documents with trading partners is a personal computer, a Web browser, and productivity tools available on the Web.

GE Trade Web works with all commercial browsers, interacts with standard Internet applications, and is accessible from any desktop system which is connected to the Web. In addition, GE TradeWeb provides security through encryption technology and mutual authentication.

Sterling

Sterling Commerce recently announced an Internet and electronic commerce access package. Sterling's COMMERCE:Connection is a suite of easy-to-use PC-based software products that allow connection to Sterling's proprietary network, COMMERCE:Network, through the Internet. This allows users to connect to trading partners using EDI standard documents, send and receive e-mail and files, post reference information in a secure library, and surf the Web.

Access to COMMERCE:Connection is obtained through an Internet Service Provider (ISP) and security is assured through the use of Data Encryption Standards (DES).

On-line Federal Government RFQ Access (CACI, Simplix, Maple Information Services, Loren Data Corporation)

One of the more widespread practices of VANs and other organizations is the development of on-line Request for Quote (RFQ) searches. CACI, Simplix, Maple Information Services (MIS), and Loren Data have all developed on-line services to provide information on government bid opportunities.

In August 1996, CACI International, Inc. introduced QuickBid Net, an Internet-based electronic value added service. QuickBid Net provides information on open government bid opportunities and enables users to electronically submit bids in response. Search tools allow users to search for RFQs via keyword or Federal Supply Code (FSC) and Federal Supply Group (FSG). This allows users to manipulate their search to be very broad or very narrow.

Simplix, Maple Information Services, and Loren Data Corporation have developed services along those same lines. These organizations offer user-friendly, Internet-based on-line searches for open RFQs using FSCs. These services are readily available to anyone who has an Internet connection and a standard Web browser.

Computer Network Corporation

Computer Network Corporation (CNC) is a DOD certified VAN which offers electronic commerce access to federal procurement opportunities

through its BidSite service. BidSite is an on-line service available to organizations which are looking to do business with the government. BidSite is protected from outside threats through the use of a firewall and access to the government marketplace is assured and authentication achieved via an identification number and password.

CNC has designed its services to include the Internet and e-mail as a means of communication between BidSite and the supplier. CNC receives a Request for Quote (RFQ) from the federal governments hubs or data centers in standard EDI formats, matches it with the appropriate suppliers based on a profile, converts the transmission from an ANSI X12 transaction set to an Internet compatible format, and e-mails it to the suppliers. The suppliers notify BidSite by responding to pricing and delivery information via the Internet and their Web browser. Data from the Internet transmission is extracted by CNC, converted to the ANSI X12 EDI standard, and relayed to the federal hub and then on to the appropriate buying site. Notification of the contract award or purchase order is conducted in the same manner with CNC providing the translation service from and to the ANSI X12 standard. In addition, the RFQs, purchase orders, and contract awards are posted on CNC's Web site and accessible by using a search engine. Although the vendor is not truly EDI capable, they comply with the federal government's mandate for EDI in procurement, using a inexpensive, user-friendly mechanism.

By 1998, CNC expects to expand BidSite's functionality by incorporating an electronic catalog of government price quotations, which will allow government organizations to do comparison shopping. This innovation will continue the process of simplifying electronic commerce access and ease of use for all participating organizations.

The Future

Major VANs are making substantial investments to securely connect their VAN services to the Internet. Instead of fighting the Internet, these organizations are embracing it and developing strategies to accommodate it. Over 55 percent of Fortune 1000 companies who currently use EDI are looking for an Internet-based alternative to help reach third and fourth tier trading partners. VANs will be developing new mechanisms to accommodate electronic commerce over the Internet and make it secure, reliable, and easy.

Some of the more prominent VANs who look to be offering electronic commerce via the Internet include IBM's Advantis and AT&T. Currently, IBM's Advantis is working on making their EDI services compatible with the Internet. They are working to integrate Internet-based technology with their IBM Global Network, which already accommodates EDI for the

manufacturing, retail, material management, and health care claims industries. AT&T will be offering just-in-time purchasing systems via Internet-based EDI. Such a project was recently undertaken with Allied-Signal in the automotive industry. AT&T is working to incorporate this service in their Internet-based electronic commerce offerings.

Table 8 outlines some of the Web EDI services and products available from VANs. Competitive pressure will cause prices to drop as more services become available. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 8. VAN Internet EDI Services

VAN	Product	Internet-based Service Description	Cost (may include full EDI services)
AT&T	EasyLink Commerce	Under development	Not yet available
CACI	QuickBid Net	RFQ search and response tool	$175 Startup $1,000/year
CNC	BidSite	RFQ search, notification, information response tool	$199 start-up $80/ month
GEIS	GE Trade Web	RFQ search and response tool	$25 start-up $65/ month + usage
Harbinger	TrustedLink Guardian	EC/EDI transaction tool	$645 startup (includes software) $50/month $.25/document
Loren Data Corp.	World-Wide EDI	RFQ notification and response service	$0 start-up $50/month
MIS	MIS on-line service	RFQ search tool	$125 start-up $75/ month + usage
Simplix	Simplix-W	RFQ search tool	$200 start-up $75/ month
Sterling	Sterling's Commerce	Proprietary network	$195/template $100/month

3.2.3 Constraints on Web-Based EDI

Many electronic commerce analysts believe the Internet is overcrowded and in need of an infrastructure upgrade. This belief that the Internet will not be a reliable medium for high volume, non-retail EDI is limiting transactions. Most users believe that the Internet is not a replacement for all VAN traffic due to reliability and security issues and concerns. They feel that Internet-based solutions may be satisfactory for small companies or for large firms which do business with smaller companies. However, many users believe that the Internet is not a viable alternative for large

firms doing many thousands of transactions on a daily basis and will have difficulty matching the security and dependability of VANs.

One of these large companies which is not embracing the Internet as a replacement for conventional EDI via a VAN is Sears, Roebuck & Company. Sears has been transmitting electronic invoices through its VAN, Advantis, for the past ten years and does not plan to change. With Internet options increasingly available, Sears still believes VAN-based EDI is the foundation of their EDI initiatives and is now converting purchase orders to VAN-based transactions. Another company, Beaver Lumber Company in Markham, Ontario, considers EDI as an interface for data going directly from one corporation's application to the trading partner's application. They believe Internet-based EDI does not lend itself to integrated EDI because of the need for human intervention. In addition, Beaver Lumber believes Internet-based EDI exposes data to theft and other risks, such as unreliable transmission and information recovery concerns.

Surveys indicate that 20 percent of EDI capable firms do not feel a need to switch to Internet-based systems. The VANs continue to provide security and reliability. VANs also provide services that cannot be replaced by Internet strategies including consulting and technical support, the ability to recover data if a problem occurs, and systems to handle direct interfacing from a large number of companies. Also, because VANs have a vested interest in the success of their clients' EDI efforts, they increase their services. Advantis helps Sears motivate suppliers to use EDI. Others run training classes for clients' suppliers.

Some critics of Internet-based EDI claim that the projected savings are not enough. Transport costs, a big savings from using the Internet, constitute only 5 to 15 percent of the total cost of a VAN operations. Significant amounts of VAN costs go to support, maintenance, and backup and recovery services. Eliminating the VAN will shift those costs to users.

The prognosis for Internet-based EDI is determined by which side of the spectrum the particular authority’s interest lies. Many Internet-based solution providers believe conventional EDI will be a dinosaur in the near future. However, while many organizations are not yet EDI capable, standards-based conventional EDI is heavily used by thousands of organizations. Therefore, it is unlikely that conventional VAN-based EDI will disappear in the near future. The termination of VAN-based EDI, if it happens, will take decades to occur.

The EPA is continuing to explore alternate methods to conventional VAN-based EDI for environmental reporting. However, caution should be exercised in evaluating new technologies to ensure they comply with

EPA's electronic reporting policy and requirements. For example, a solution which eliminates a standard from electronic transmissions makes integration with internal computer applications difficult to achieve. A careful evaluation of the technology and EPA requirements must be performed prior to using any evolving technology.

3.3 Standards-Based EDI via the Internet

Although reliability and security are primary concerns when using the Internet for EDI, not all products and services support a standard format for transmission of the business information. Many products and services do not use an accepted EDI standard, such as ANSI X12 or UN/EDIFACT, and are low volume solutions designed to enable small firms to participate in specific electronic commerce initiatives. In addition, low volume generally means non-integrated. Low volume often prevents development of a good business case which will justify integration time and expenses. Exchange of business information must be based on a standard to enable integration with a company's internal business applications to realize the full benefits of an electronic commerce solution.

3.4 EDI Transmission Products for the Internet

As noted earlier, many products support electronic commerce via the Internet. Table 9 provides comparison capability and pricing information regarding products which support an accepted EDI standard which may be suitable for EPA purposes. In addition, one product is reviewed in detail to assess the advantages and disadvantages of these types of products. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 9. Standards-Based EDI Products for the Internet

Vendor	Product	Description/ Functionality	Standards Support	Cost
AAKRUTI, Inc.	EDIrect	EDI via Internet real-time processing; digital certificate authentication; integration	ANSI X12 EDIFACT	$5,000/server $500/client
EDI Integration Corp.	Eagle EDI Translator	Interacts with the Internet in place of a VAN; FTP or MIME; hardware encryption optional	ANSI X12 EDIFACT	$300 - Eagle $360/yr. maint. $880 encryption
Extol, Inc.	Extol EDI Integrator	Complete document translation; message/batch transfer; supports encryption solutions	ANSI X12 EDIFACT Other proprietary	$10,000-$50,000 depending on platform
Fisher Technology Group	CornerStone	Web commerce solution; buying & selling organizations	ANSI X12	$60,000
Notto Corporation	System.EDI	Full feature EC/EDI application; Standard Edition for end users; Integrator Edition for integration with other applications	ANSI X12 EDIFACT	$300-$600 Maintenance varies by user requirements
PaperFree Systems	WinMap, E-Server	GUI development tools; multi-platform; EDI/EC gateway for communications and EDI message management	ANSI X12 EDIFACT TDCC UCS, HL7	$3,500-$65,000
Premenos Corp.	Templar	Secures, transmits, receives, and track EC using EDI over the Internet; compatible with any EDI translation software package	All	$400-$24,990 depending of platform
Sparta, Inc.	SecureEC	Provides encryption, digital signatures, authentication, non-repudiation; public/private key management	ANSI X12	$2,500 PC platform plus 15% maintenance/year
Telink Systems, Inc.	TeLink/ Gateway	Full featured EDI via the Internet product; allows integration with other applications	ANSI X12, EDIFACT, UCS, VICS	Not published
TSI International	Mercator for the Web	Any-to-any data transformation for seamless interfaces between applications; pre-built adapters for connecting EDI, HL7, relational databases, HTML	ANSI X12, EDIFACT, HL7, Tradacoms	$3,000 basic tool

3.4.1 Templar

Templar is a message system which allows secure transmission of business-sensitive documents over an open, unsecured network like the Internet. Although it does not replace EDI translation software, it will function in combination with most EDI translation products. It costs approximately $450 for the Windows version and $6,000 for a UNIX version.

The National Electronic Commerce Resource Center (ECRC) Program's Technology Development Activity (TDA) recently conducted a technical investigation to determine if Templar is a practical, viable tool to facilitate EDI via the Internet. Extensive research was conducted, and a plan to implement Templar and its required components in a simulated business environment was formed.

Templar uses security specifications decided upon between trading partners It resides between the EDI translator and the mail/message system, Chameleon E-mail, on the organization's computer system. In addition to providing security and integrity for EDI documents, Templar provides an audit log of EDI transmissions and Templar processing functions. Figure 2 depicts the basic Templar processing flow.

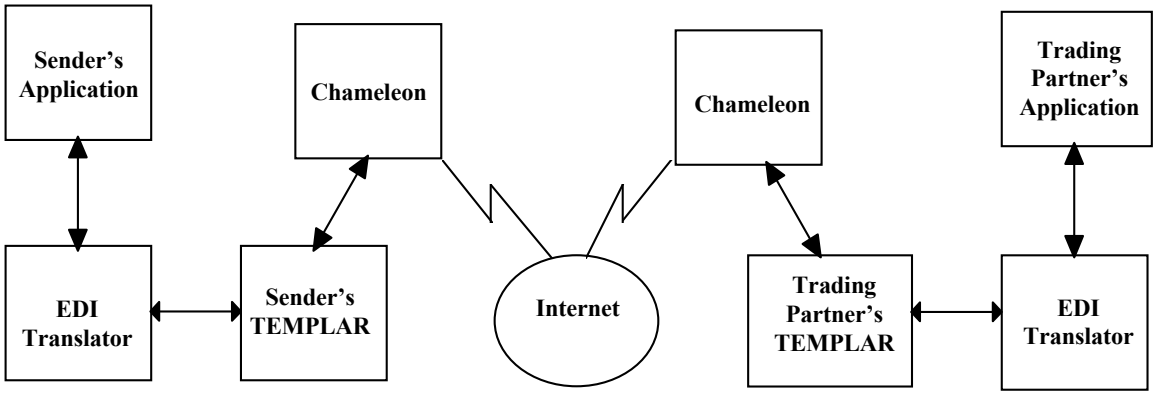

Figure 2. Templar Processing Flow

Templar provides security by encrypting and decrypting EDI interchanges and, as an added measure of security, allows you to digitally sign transmissions for authentication and non-repudiation.
Secure/Multipurpose Internet Mail Extensions (S/MIME) is the messaging standard which Templar uses to envelope secured messages. S/MIME uses and supports the following:

- Multipurpose Internet Mail Extensions (MIME): an e-mail standard used for encoding, labeling, fragmenting and reassembling multi-part messages
- Public-Key Cryptography Standards #7 (PKCS#7): used for encryption, decryption, authentication and non-repudiation of data
- Message Digest Algorithm (MD5): ensures the integrity of the transmitted data
- ANSI X509: the standard used for the digital certificate which connects the trading partner with their public key.

Templar is able to work with the following EDI enveloping standards; ISA within the ANSI X12 standard and UNB with the EDI for Administration, Commerce, and Transport (EDIFACT) standard. The different methods that Templar can transmit data are:

- E-mail - interfaces with Simple Mail Transfer Protocol (SMTP) compliant systems, and
- File interface - used for routing secured messages through other communications paths or proprietary networks.

For additional security, trading partners can add another layer of security that uses a digital signature. A digital signature is an encrypted character string which is generated from a mathematical algorithm. The character string identifies the creator and because of the way it is generated, cannot be forged. The digital signature is comparable to a handwritten signature.

3.4.2 Templar Authentication

Authentication is a process used to ensure the identities of the sender and receiver of the EDI interchange, the contents of the data are valid and have not been compromised. The authentication is two-sided. It proves the non-repudiation of origin to the receiver of the EDI interchange and the non-repudiation of receipt to the sender.

To verify the authenticity and integrity of a received, digitally signed, encrypted EDI interchange in S/MIME format, the following occurs:

- Templar decrypts the MIME message and calculates a value through a mathematical algorithm called a message digest.
- Templar uses the sender's public key to decrypt the digital signature. The decrypted digital signature is a message digest calculated from the same MIME message.
- Templar compares the two values. If they match, the integrity of the document and the identity of the sender are validated and verified.

This process is called the non-repudiation of origin.

After the identity of the sender and the integrity of the EDI interchange is verified, the receiver, through Templar, sends an acknowledgment called an AUTACK. This verifies that the EDI interchange was received by the intended trading partner. The AUTACK or acknowledgment is enveloped the same way as the EDI interchange. It is an encrypted, digitally signed document in S/MIME format. The receiver decrypts the AUTACK in the same manner the sender decrypted the received EDI interchange.

When the AUTACK is successfully decrypted, Templar compares the information on the AUTACK with the original EDI interchange. Both of the documents contain sender and receiver interchange information, that is, the computed message digest of the EDI interchange and the EDI interchange control numbers and other pertinent information contained within the EDI interchange. If these values match, the sender of the EDI interchange knows that the intended receiver processed their document. This completes the validation and verification cycle of a transmitted document.

3.4.3 Templar Conclusion

Templar requires that every trading partner who desires to use the Internet to exchange EDI documents should have similarly configured processing environments. Specifically, Templar only interfaces with one network/e-mail application, Chameleon. This requires every trading partner to use Chameleon as their network/e-mail application. In addition, another problem is intermingling of processing platforms and environments. The ECRC TDA's simulated business environment was to have one firm operating on a DOS platform and the trading partner operating on a Windows NT platform. Currently, Templar does not support the Windows NT environment.

These deficiencies forced the ECRC TDA to change both prototype companies to process on the same platforms. Even though Templar will function efficiently in similar environments, the ECRC TDA's experience suggests that Templar is a point-to-point solution for EDI over the Internet. Although solutions for these deficiencies are being developed by Premenos, Templar is not practical in typically diverse business environments which exchange EDI documents with many different organizations.

3.5 Web-Based Forms

Since the federal government, particularly the DOD, moved to EDI for procurement, a need existed for an unconventional approach to enable small suppliers to participate in federal EDI initiatives. During the evolution of the Federal Acquisition Computer Network (FACNET), it became apparent that conventional EDI was beyond the reach of many small businesses which possess neither the time, capital, or expertise to implement an integrated EDI system. A low-cost, user-friendly interface to FACNET was required to enable suppliers to operate within the FACNET infrastructure.

The startup of several new companies and certain firms expanding their existing services and product lines to offer FACNET connection services without implementing conventional EDI meets this need. As discussed earlier in the Federal Government RFQ Access section, these VANs have deployed Internet-based services available to suppliers via a Web browser and/or their e-mail system. These services permit small suppliers to access, review, bid, and receive awards for government business without being truly EDI capable. The typical approach is to furnish the Request for Quote to the supplier via e-mail or Web browser search capability, furnish a template or form to submit the bid, and award the Purchase Order via an Internet transmission.

These companies convert the Internet-based transmission into a ANSI X12 EDI transaction set, send it to the DOD's FACNET hubs, and translate FACNET EDI transmissions into a format for return to the supplier via the Internet. The supplier is EDI capable to the government buying site. The acceptance and popularity of this solution has led the large, well-established VANs, such as General Electric Information Systems (GEIS) and Harbinger EDI Services, to deploy similar solutions.

This philosophy can be used by the EPA to capture environmental compliance reports electronically without requiring small business and industry to become EDI capable. The large number of small firms throughout the country, although having limited reporting requirements, creates a significant amount of EPA labor and effort to capture, compile, and report environmental information. Using this approach can assist the EPA in streamlining environmental information flow by providing an alternative solution to conventional EDI.

3.6 EPA Web Solution Scenario

Conventional EDI represents an opportunity for EPA to reduce operating costs significantly while increasing organizational efficiency. In the conventional EDI model, the reporting organization has an EDI translation software package and an electronic mailbox with a VAN. The reporting organization uses the EDI translator to package reports into a standard format and uses a VAN mailbox to

exchange data. This method of doing EDI requires an investment in EDI translation software and service charges from the VAN for maintaining the electronic mailbox and providing the communication service. If the reporting organization is using EDI for other business processes and documents, the firm merely needs to expand their existing EDI capability to submit EPA compliance reports.

As outlined earlier, Web-based tools are being developed and used to facilitate EDI via the Internet. Commercial businesses and other organizations are using the Internet and the Web to conduct various types of electronic commerce. Web technology is advancing at a rapid pace with Web applications and tools paving the way for a shift of electronic commerce and EDI processing to the Internet. The EPA is exploring the financial impact and operational benefit of using the Web to submit environmental reports for both the reporting organization and the EPA.

One method involves collecting reporting data via the Internet. This is just one method, which *CTC* researched, when considering the EPA's needs and goals. It does not represent an endorsement of this method, however, further exploration of this type of methodology is viable. This method is cost effective for both the EPA and the reporting organization. Reporting organizations using this system will not require EDI translation software or the services of a VAN. This option allows the EPA to replace paper submissions of compliance reports from companies without requiring those firms to implement or expand conventional EDI programs.

3.6.1 EPA Reporting Via The Internet

As the EPA expands electronic commerce initiatives, electronic receipt of environmental reports will increase. Conventional EDI will be the transport mechanism for the bulk of electronic reports, particularly from high-volume submitters. However, not all reporting organizations will be capable of using conventional EDI to submit reports. Smaller organizations will lack the technical and financial resources to use conventional EDI. For these companies, an alternative method of submitting electronic reports is needed. Internet technology can provide alternative electronic reporting tools for these organizations.

3.6.2 Technical Approach

Electronic report submission via the Web Using can readily be made available by using COTS software, shareware, and custom-created interfaces. Figure 3 depicts this approach.

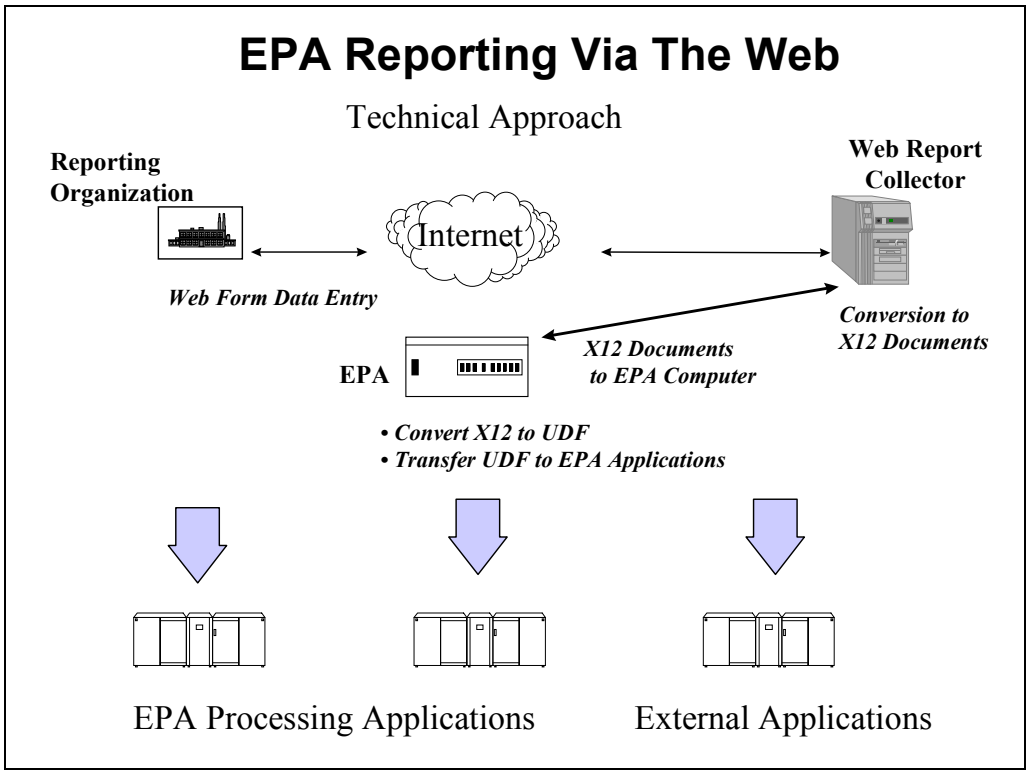

Figure 3. EPA Reporting via the Web

The process would work in the following manner.

1. The reporting entity accesses the Web Report Collector, a Web site hosted by the EPA for collecting report data.
2. The reporting entity enters data into a Web data entry form. Theoretically, forms for any of the reports which the EPA can receive electronically or any other paper-based report could be supported at the Web site.
3. Report data entered by reporting entities is collected into a database contained on the Web Report Collector server.
4. A function is executed on the Web Report Collector which extracts all database records contained in the database. Extracted records are passed to an EDI translator residing on the collector machine.
5. The EDI translator will create an appropriate ANSI X12 report document for all extracted database records. The EPA implementation convention will be used for creating these documents.
6. The ANSI X12 report documents will be transmitted either directly to EPA or via the EPA's VAN to an EPA computer that has an EDI translator.
7. The EPA translator will unwrap each of the ANSI X12 documents into the proper User Defined File (UDF) format or flat file.

8. The EPA will route each UDF to the proper processing application where it will be imported into the application database.
9. The EPA can transmit the ANSI X12 document or the UDF to any external application, including another federal agency, state agency or any internal EPA application system.

3.6.3 Costs to the EPA

The costs of developing a Web reporting application, as depicted in Figure 3, will depend upon the computer hardware platform selected for implementation. UNIX computing platforms and software are more expensive than PC platforms and products. Anticipated report volume, data processing requirements, data storage requirements, and complexity of processing applications by the Web Report Collector must be evaluated to determine the platform to be used. A breakdown of the estimated costs of establishing and maintaining the Internet report application is provided. Security issues and costs are presented separately in Section 4.0 of this document and are not discussed here. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service. The EPA can use this information as a reference when considering the possible cost of such an approach.)*

Table 10. Estimated Costs to Establish an Electronic Reporting Web Server

PC Platform		UNIX Platform	
Description	**Est. Cost**	**Description**	**Est. Cost**
Hardware		Hardware	
Intel-based PC 266 MHz 10 GB Hard Drive Storage CD-ROM 128 MB RAM Monitor, keyboard, mouse	$5,500	SunSPARC 10 10 GB Hard Drive Storage	$30,000
Software		Software	
EDI Translation Software	$5,000	EDI Translation Software	$50,000
Web server	Freeware	Web Server	$750
Sequel Server Database and Internet Tools	$4,500	Oracle Database	$1,475
Common Gateway Interface	$500	Common Gateway Interface	$500
Total PC Cost	$15,000	Total UNIX Cost	$81,975

The cost for developing the Web data entry forms and application will be approximately the same for the PC and UNIX platforms. Actual costs will depend upon the complexity of the design. A rough estimate for developing an application that contains one entry form supporting the collection and processing of one report document from the Web collector to the EPA application is approximately $100,000. Additional forms could be added to an existing application for approximately $60,000 each. A detailed requirements analysis of the EPA procedures, data reporting requirements, and technical guidelines for the specific report is required to develop an accurate cost estimate for the Web collection application. In addition, EPA required levels of security will affect the overall cost for the system.

Administration and maintenance of the application is an ongoing cost estimated at 25 percent of a full-time employee, approximately $15,000 per year. Annual maintenance fees for purchased software have not been considered, but generally are ten to twenty percent of the purchase price for a typical PC or UNIX package.

The total cost of a Web report collection scenario would be approximately $115,000 to create the application on a PC platform and $181,975 on a UNIX platform. Recurring annual maintenance costs are estimated at $15,000. The UNIX costs are provided in the event that internal EPA policy dictates a UNIX platform or an analysis of EPA functional

requirements indicate a UNIX platform will be most efficient operating platform for the system.

3.6.4 Benefits for the EPA

By developing a Web collection application, the EPA can potentially obtain the following benefits:

- Reduction of operating costs and improvements in operational efficiency will be achieved.
- EDI incapable organizations can submit reports electronically without expensive EDI products and services.
- EPA can avoid VAN charges by using the Web Report Collector for communication of documents, unless the EPA wants to route all electronic reporting submissions through a VAN.
- Paper reporting is shifted to electronic media thereby reducing expensive manual processing.
- Organizations that do not use conventional EDI can submit reports electronically.
- EPA goals for electronic reporting are supported by not imposing costly, time consuming, highly technical solutions on business and industry.
- Presidential directives for moving federal government agencies to electronic commerce will be accomplished.

All of these benefits support the Federal Government and EPA goals to expand electronic commerce utilization to the maximum extent possible. This approach furnishes the ability for more EPA trading partners to participate in electronic reporting initiatives, provides an alternative, low cost, easy to use solution for small or large organizations, and meets the EPA requirement to not force trading partners to use a specific or proprietary software solution.

3.6.5 Costs to the Reporting Organization

The reporting organization requires only a PC, access to the Internet, and a Web browser to submit reports using this system. If the reporting company has a PC, the only cost is Internet access charges via an Internet Service Provider (ISP). This will be about $20 per month; however, competition is driving this price lower in some areas. Web browser software is usually provided by the ISP or can be obtained free. If the reporting entity does not have local call access to his ISP, the submitter will pay long distance charges for the time spent connected to the Internet. However, most ISPs provide local or toll free access to their service. If

the reporting organization does not have a PC, it will cost approximately $2,000 for a suitable PC setup. Additional costs will be incurred to train an individual on use of the PC and Web browser which will be used to enter information into the system. However, these training costs will be significantly less than training costs required to implement a conventional EDI system.

3.6.6 Benefits to the Reporting Organization

The following are potential benefits to the reporting organization if the EPA establishes a Web-based the Internet collection method:

- Costs of EDI software and services are avoided.
- The technical challenges of implementation and maintenance of EDI are avoided.
- Data entry is simple and easy to accomplish.
- Organization's environmental information need not be captured electronically to submit reports; this can prevent costly modifications to internal computer systems.
- This method enables organizations to comply with the federal mandate to use electronic commerce and EDI.

3.6.7 Web Solution Summary

CTC has estimated that it will cost the EPA between $115,000 (PC Platform) and $181,975 (UNIX) to develop a Web collection application that can process one environmental report. Additional report capabilities can be added for approximately $60,000 for each report. On-going maintenance of the system will cost approximately $15,000 per year. Startup costs for the reporting organization will be approximately $2,000 if a PC needs to be purchased. Ongoing costs for the reporting organization is estimated at $20 monthly, depending on the ISP.

The EPA will shoulder the burden for developing this system and incur the most expense. Reviewing the potential operational cost savings provides a business case for developing the Web reporting application. In the absence of benchmarking cost information, a structure for comparing the costs of processing a paper environmental report versus the cost of processing the report as received from the Web collection application can be developed using industry statistics from EDI implementations.

Successful EDI implementations have shown a broad range of savings statistics. Sources used in this analysis cite reductions in the costs for processing purchase orders range from $50 to $5 to as much as $78 to

$.50. This translates to a $45 to $77 reduction in the cost per document. Other savings figures reported show a similar disparity for commercial and government conversions from paper to EDI.

A conservative estimate of cost savings will be used to provide a business case for the EPA. The Defense Finance and Accounting Service (DFAS) is a DOD agency which charges government customers approximately $19 to process a paper invoice. Industry surveys indicate that it costs approximately $4 to process an invoice received via EDI. If the survey costs are applied to DFAS, each invoice received via EDI should cost $15 less to process. A conservative savings of $15 will be used as compared to the figures reported by other industry studies for purchase orders. Using this figure to determine savings, the EPA will reduce the cost of processing an environmental report by $15 dollars.

To compute the return on costs of implementing one environmental report using a Web reporting system, the implementation cost is divided by $15. This will provide the number of environmental reports needed to be processed at the reduced cost to justify the investment. At a $15 dollar reduction in processing costs, the PC platform requires 7,700 reports, and the UNIX platform requires 12,132 environmental reports to be processed to cover the costs of the Web collection application. Approximately 1,000 reports per year would be required to cover the annual maintenance costs on both platforms.

The EPA processes thousand of reports each year. Realistically, it may not be possible for all reports to be collected using the Web collection application previously discussed. To view prospective savings if a significant volume of reports is received via this application, the cost reduction for processing 100,000 report documents will be considered. At a saving of $15 per report, the net reduction in cost is $1.5 million.

The actual costs for developing the Web collection system may differ from those presented here depending on the results of a detailed analysis of EPA requirements. However, the net cost reduction for successive years would increase as additional organizations use the system and the overall volume increases.

Reduced operating costs provide a clear business case for using Internet and Web technology to support the collection of environmental reports. In addition, other intangible benefits as discussed earlier will also be gained.

3.7 eXtensible Markup Language (XML)

eXtensible Markup Language (XML) is another evolving technology which may play a role in future electronic commerce advances. XML is a subset of the

International Standard Organization's (ISO) Standard Generalized Markup Language (SGML) and was developed in 1996 and 1997 by the World Wide Web Consortium (W3C) SGML on the Web working party. The formal specification was submitted for approval by W3C members on July 1, 1997. XML is intended to provide a freely available, widely transportable method for well-controlled data interchange. The goal of XML/EDI is to deliver simple, durable and effective business transactions via electronic means.

XML was designed for the exchange of information in the form of computer displayable documents. Not all commercial data is interchanged in a displayable format. In particular, data designed for EDI typically needs to be processed before it can be displayed. For this to be possible, the data must be mapped to a template using a set of rules. The XML/EDI guidelines provide a standardized way in which such templates and rules can be added to interchanged data.

The XML/EDI guidelines begin by formally defining the terms used in the text. An impact statement is created to make predictions on relevancy and usage of the text from various viewpoints. The guidelines then give a background on the use of tools and standards which XML/EDI is built. It is anticipated that future versions of the guidelines will update component details as they are refined and relevant tools are built.

Combining XML and EDI to develop XML/EDI may shift the main method of capturing and coding EDI information to XML coded electronic forms. In addition, the XML/EDI specification shows how EDI messages can be generated from and to XML/EDI forms. XML/EDI may be used to define how companies can use current standards to solve their business problems.

What does XML/EDI mean for users of EDI? At this time, the consensus within the XML development community believes that business transactions will evolve to take place mainly within desktop computers, using:

- a general-purpose document browser as the user interface
- a common language for the description of templates and associated conversion rules, and
- distributed processing to support centralized functions.

Just as in Internet-based EDI, XML utilization will be dependent on each organization's electronic commerce requirements. It will likely become another tool to supplement, but not replace, current electronic commerce technologies. XML/EDI will be a candidate to support the evolution of electronic commerce by allowing users with the business knowledge to be more independent, and allowing documents to be defined and issued by their users rather than data processing specialists.

3.8 Relevance to EPA

Even though a portion of the regulated community will be willing and able to implement conventional EDI to submit environmental reports electronically, these organizations, most likely, will be large firms. The EPA needs to provide optional, low-cost, easy to use solutions to attract a significant portion of its trading partner base. The volume and frequency of reporting requirements will not justify implementing EDI for electronic reporting for SMEs and other small organizations. Internet applications can play a key role in allowing small organizations participate in electronic reporting initiatives. The challenge for the EPA is to provide practical, viable alternatives without compromising internal EPA requirements. As this sections shows, many rapidly emerging technologies make this attainable by offering solutions besides conventional EDI.

4.0 ELECTRONIC REPORTING SECURITY ISSUES

Information Systems Security (ISS) is a requirement to help achieve acceptance of using electronic commerce for electronic reporting. All organizations planning to implement electronic commerce must have a capable ISS program. A capable ISS program includes risk management, establishing a security policy, and implementing a disaster recovery program. To establish an effective ISS program, there are six key issues that must be addressed. These issues are relevant to the success of any electronic commerce initiative.

1. Authentication of participants
2. Non repudiation of activities
3. Information integrity
4. Confidentiality
5. Availability of resources and services
6. Access control

Prior to addressing any of these issues, a key issue is to establish an overall policy for your organization's information and computer systems security. The purpose of a security policy is to define and document security requirements, risks, and protection needs, minimize the impact and cost of security incidents, and establish definitive reference points for audits. The security policy must be adhered to and programs and procedures implemented to meet the goals of the policy. Education and training of the organization's staff is a key element to give visibility and credibility for the security effort.

4.1 Security Requirements

Security requirements vary depending on the nature of the organization, sensitivity of the computer systems and information, and evaluation of risk. Most security breeches are the result of internal organizational threats as opposed to

external threats. However, both threats need to be addressed as part of the overall security policy.

Security is addressed by investigating the ways information and reports are stored, used, and transferred. Information is stored, warehoused, or archived, and security measures must be established to ensure that stored information cannot be compromised. That includes information systems security at the site of the created report and at all recipient sites. Proper information systems security measures need to be implemented at each site that stores a copy of the report.

Reports and information are also transmitted from one location to another. Security measures must be established to ensure that information is not compromised while being transmitted. VANs have successfully addressed most issues in the area of conventional EDI but the transmission of information over the Internet introduces numerous possibilities for the information to be corrupted, stolen, or viewed by unauthorized individuals.

The ISS program demands continual vigilance, metrics gathering, and a process for continual improvement. The appropriate level of information systems security education and training needs must be provided to the information systems staff, enterprise staff, and the customer/supplier chain. The growth in the Web and distributed computing has led to an increase in computer-related crime. This has caused an increase in legislation and regulations that establish legal requirements for networks and information security. There are laws that govern information security in many businesses, including banking, health care, and the government.

Various standards have emerged to support the need for network security. The use of standards compliant information/network security provides the best assurance of high quality, effective security that conforms to legal requirements. For example, in banking, the Uniform Commercial Code (UCC) provides legal standards for most types of financial transactions. Under UCC Section 4A-202, a payment order is effective as the order of the customer if the security procedure is a commercially reasonable method of providing security against unauthorized payment orders. This places the risk of loss on the customer if a bank accepts a payment order that is in compliance with a commercially reasonable security procedure. Commercially reasonable security methods are defined in Table 11.

Table 11 also illustrates some of the standards that have been established to support security related electronic commerce issues. ANSI sets standards for the banking industry while the Federal Information Processing Standards (FIPS) sets standards for the federal government. The International Standards Organization and the International Electro-technical Commission (ISO/IEC) set international standards. The Internet Engineering Task Force (IETF) is the organization who sets the standards of the Internet. IETF is part of the Internet Architecture Board (IAB) which is supported by the Internet Society. The Internet Society is an

international non-profit organization that was established in 1992 to help monitor the workings of the Internet.

Table 11. Electronic Commerce Security Standards

Security Service	Standards			
	ANSI	FIPS	ISO/IEC	IETF
Data Encryption	X3.92,X3.106	FIPS 46,74,81	8372, 10116	1829
User Authentication	X9.26	FIPS JJJ (draft)	9798, 11131	1334
Message Integrity	X9.9, X9.19	FIPS 113, 180-1	9797, 8731	1826,1827,1828,1852
Key Management - Symmetric	X9.17, X9.24	FIPS 171	8732, 11568	-----
Key Management - Public/Private	X9.42 (draft)	-----	9594-8, 11770-3	OAKLEY/SKIP/ISAKMP (IPSEC drafts)
Certification Authority	X9.55, X9.57, X9.62	-----	9594-8, X.509	X.509 (PKIX draft)
Digital Signature-DSS	X9.30	FIPS 186	9594-8	-----
Digital Signature-RSA	-----	-----	9796	-----

In addition to these standards, ANSI X12 has defined a transaction set to address EDI transactions, including EDI transmitted over the Internet. Transaction set 815 of the ANSI X12 standard covers the "Cryptographic Service Message."

4.2 Authentication

Authentication is a process used to verify the identity of the participants in a transaction. Reliable authentication mechanisms are required for electronic commerce over the Internet for it to become fully accepted. Digital signatures in coordination with digital certificates are enabling technologies with which to implement an authentication mechanism. The enforcement of a strong password policy also enables authentication. Smart cards are an emerging technology that provide authentication capability. Authentication using biometrics techniques, such as fingerprint identification, voice recognition, and hand writing analysis are increasingly being used. Biometrics, smart cards and combinations of the two technologies will become more prevalent in the near future.

Table 12. Authentication Issues, Threats, and Solutions

Security Issue	Security Threat	Enabling Technology	Implementations
Authentication	Impersonation	Hash functions/digests. Cryptography.	Digital signatures and Code signing. RSA, PGP

			Others
		Digital Certificates	Issued by certification authority.
		Strong Password Enforcement	Kerberos. Use tools: Crack, COPS.
		Biometrics measures	Fingerprint Identification.
		Smart Cards	FORTEZZA, RSA, others.
		One time passwords.	Bellcore's S/Key, OPIE.

Authentication technologies can be implemented at different levels of investment. Kerberos is a free-ware user authentication package that is available from the Massachusetts Institute of Technology (MIT). Digital certificates are issued by certification authorities and cost approximately $200. Smart Cards are the most expensive, especially those utilizing biometrics. Existing standards that address authentication include ANSI X9.26, the Challenge Handshake Authentication Protocol (CHAP), and the Password Authentication Protocol (PAP). The JJJ draft from FIPS is proposing to use the Digital Signature Standard (X9.30) in user authentication applications.

4.3 Non-repudiation

Non-repudiation provides a record of transactions to prove that a transaction has occurred. In case of electronic reporting, authenticity of both the contents of a report and the sender can be verified using a combination that includes digital signatures and digital certificates.

Table 13. Non-repudiation Issues, Threats, and Solutions

Security Issue	Security Threat	Enabling Technology	Implementations
Non repudiation	Denial of transactions occurrence.	Digital Signatures, Digital Certificates, Cryptography. Time Stamping. Transaction Logs Standards/ Protocols	S-HTTP/SSL. Industrial standards such as the SET protocol.

4.4 Information Integrity

Information integrity guarantees that the information has not been altered in any intentional or unintentional manner. This issue also must provide a mechanism to restore the valid information if it is lost or corrupted.

Table 14. Information Integrity Issues, Threats, and Solutions

Security Issue	Security Threat	Enabling Technology	Implementations
Integrity	Loss of information or the corruption of information. Viruses - time bombs, Trojan horses	Hash Functions/Digests recognize corruption of data. Checksums recognize corruption of data. Disaster Recovery Program. Redundant systems. Use virus inoculation software.	Digital signatures. Code signing. Data backups. Off site storage, RAID technology. Norton, McAfee.

4.5 Confidentiality

Confidentiality ensures that the information will be readable to only a select subset of individuals while all others are prevented from gaining access. Cryptography is one example of a technology that can be used to enable confidentiality.

Table 15. Confidentiality Issues, Threats, and Solutions

Security Issue	Security Threat	Enabling Technology	Implementations
Confidentiality	Intellectual property of the enterprise could be stolen/exposed.	Cryptography Public/Private key pairs Symmetric Keys	RSA and PGP provide a public/private key. DES uses a symmetric key.
	Private/Personal information could be exposed.	S-HTTP/SSL provides application layer confidentiality.	Terisa Systems S-HTTP. SSL available on most web servers. Netscape, Microsoft, and others.
		SKIP for IP level cryptography.	SUN's Elvis+, and others.

4.6 Information Availability

Resources and services must be available to provide the required services for electronic commerce implementation. An electronic media-based enterprise can not function if resources and services are not readily available. There have been numerous reports of server sites being made inoperable through "denial of service" attacks. Unfortunately there is little that can be done to prevent the denial of service attacks such as the "ping of death" and "syn" attacks. These attacks can destroy computer system functionality by deluging the system with a large number of messages or sending improperly formatted data which can harm a computer system and may not be traceable back to the originator.

Table 16. Availability Issues, Threats, and Solutions

Security Issue	Security Threat	Enabling Technology	Implementations
Availability of Services and Resources	Denial of Service Attacks "Syn" "Ping of Death"		
	Viruses - time bombs, Trojan horses.	Use virus inoculation software.	Norton, McAfee, others.
	Loss of service/data.	Disaster recovery plan. Redundant systems.	Provide contingencies for data and services. RAID technology for disks.

4.7 Access Control

Access control authorizes users to have access to pre-approved levels of services and resources. Access control covers a wide range of topics from physical access control to logical access control including access control lists and remote access. It should be difficult to gain access to important resources and information

without the proper authorization. Key equipment should be secured in locked rooms accessible only by authorized personnel. Access to computers should be secured through password protected interfaces and screen savers.

Table 17. Access Control Issues, Threats, and Solutions

Security Issue	Security Threat	Enabling Technology	Implementations
Access Control	Unauthorized access to key information and resources over the Internet.	Restrict network access to IS.	Firewalls routers proxy servers
		Access control features.	Screen Savers. Delete old accounts. Access control lists. Role based AC.
	Theft of equipment and resources.	Physical security measures	Restrict access to key rooms and equip.

4.8 Enabling Technologies

There are many technologies and products which address the threats discussed above. Many products address multiple threats while others are strictly to combat one threat. Examples of some of the products and costs are shown in Table 18. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 18. Internet Security Products

Company	Product	Features	Security	Price
Cyber-Safe	Shades	Encryption program used in electronic communications and data storage.	Encryption.	Single user $149. $95/user for 10 users.
IBM	Cryptolope	Message encryption, verification, and authentication.	Encryption.	Not published
Security First Technologies	HannaH	Authentication, encryption, and message integrity.	Encryption. Digital signatures.	$100/node. Starter kit is $2995 for 10.
Premenos	Templar	Ensures confidentiality of EDI and mail. Provides non-repudiation of both sender and recipient.	Encryption.	$449 for Windows 3.1. $5,990 for Windows NT and UNIX.
RSA Data Systems	Bsafe, TIPEM, RSA Secure	Bsafe is a general purpose developer kit for cryptographic applications.	Encryption. Digital Signatures.	$290 Bsafe and TIPEM. $99 RSA Secure .
VeriSign	Certificate Issuing System ,CSI. Certificate Signing Unit ,CSU.	Notarizes the relationship between the public key and the identity of the holder of that key.	Encryption. Digital Certificates.	Based on security model class.
SPARTA, Inc.	SecurEC	Uses the X12.58 security extension to ANSI X12 to support EDI over the Internet. It is a combined hardware and software product. Provides non-repudiation of sender.	Encryption. Digital Signatures.	$2,500 for Windows. $17,000 for UNIX and Windows NT Server. $19,000 for OS/400.
X-Change Software/Spyrus Inc.	X-Change Windows EDI, Privacy Card/SPEXS	Security at the user-to-user level on PCs or Internet e-mail/FTP.	Encryption.	Under $1,000.

Cryptography

Cryptographic systems provide a method to encrypt information ensuring that decrypting the message is not possible without the encryption algorithm. Current key-based cryptographic techniques include symmetric and asymmetric key systems called public key systems that use public/private key pairs. The symmetric key system uses the same key to encrypt and decrypt the message. This key must be shared by the sender (encryption phase) and the receiver (decryption phase) and is currently implemented in the federal government's Data Encryption Standard (DES) adopted in 1976.

Public key systems work along the same principle as the encryption/decryption actions used in digital signatures, only in an opposite sense. In public key encryption, the sender of the information encrypts the source file or message using the recipient's public key. The encrypted message is sent to the recipient and decrypted using the recipient's private key as depicted in Figure 4. The public/private key pair is mathematically linked so that information encrypted using one of the keys can only be decrypted using the other.

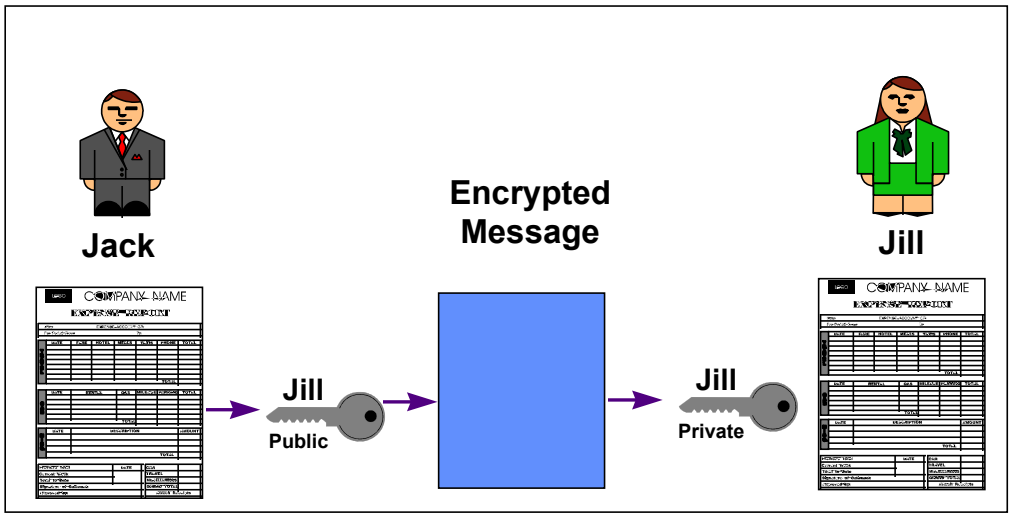

Figure 4. Jack sending a public key encrypted message to Jill.

Public key cryptosystems are significantly slower than symmetric systems. Public/symmetric hybrid cryptosystems systems are often used. The hybrid systems typically use public key cryptography to transfer a session key between sender and receiver. This session key is then used as the symmetric key for the message transfer. These hybrid cryptosystems are much faster than public key systems and offer more secure key management than pure symmetric systems.

Digital Signatures, Certification Authorities, and Digital Certificates

Digital Signatures can be used in providing authentication, non-repudiation, and information integrity. A digital signature is created using two distinct functions. A one-way hash function is used to establish information integrity, while a cryptographic system using the private key of a private/pubic key pair is used to establish the identity of the message owner or sender as shown in Figure 5. In message transmissions, this digital signature provides a mechanism to authenticate the sender of the message, to ensure that the transmitted document has not been modified, and to provide the recipient with a record that the message was sent. This information shows non-repudiation of the sender of the transmitted document.

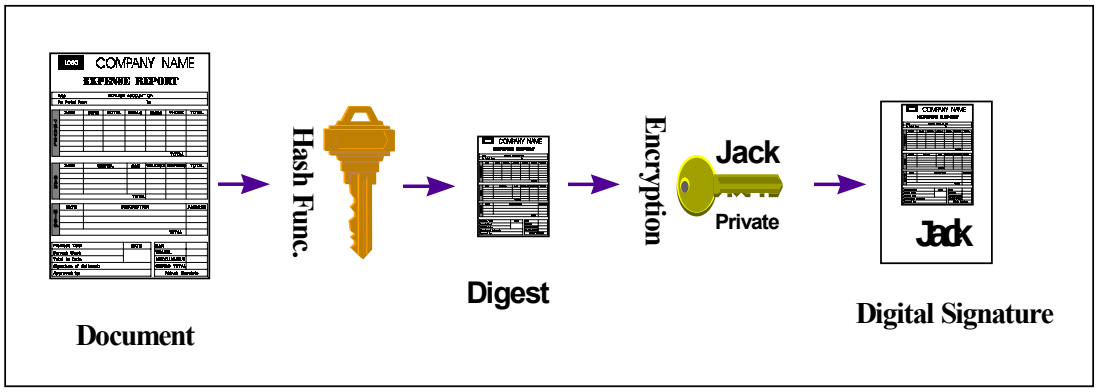

Figure 5. Digital Signature

When a message is to be securely transmitted, the digital signature is appended to the actual document. This combined message, plus a signature, is then encrypted with the public key of the recipient and transmitted to the recipient as depicted in Figure 6. Upon receiving the encrypted message, the recipient decrypts the entire message with the private key. The document and digital signature are isolated and the recipient uses the sender's public key to decrypt the digital signature to get the sender's document digest. The recipient then generates a digest of the document using the same hash function that the sender used and compares this digest to the decrypted sender's digest. If these digests are equal, the document has not been altered, and the sender can be identified by his public key.

Concern about the identity of the sender may still exist. The recipient knows only that the sender is in possession of the unique private key used to encrypt the message that the recipient successfully decrypted with the corresponding public key. The identity of the sender may not be known. The role of the digital certificate provides the link between the public key of a unique private/public key pair and the identity of a group or individual. It is the combination of the digital signature and digital certificate that fully provides authentication, integrity, and non-repudiation of the sender in a transaction.

The Certification Authority (CA) is a trusted third party that issues, archives, and revokes digital certificates. CAs can issue digital certificates to individual entities or other CAs. CAs also issue certificate revocation lists (CRLs) periodically and post certificates and CRLs to a repository. The CRLs contain lists of revoked but unexpired certificates issued by the CA.

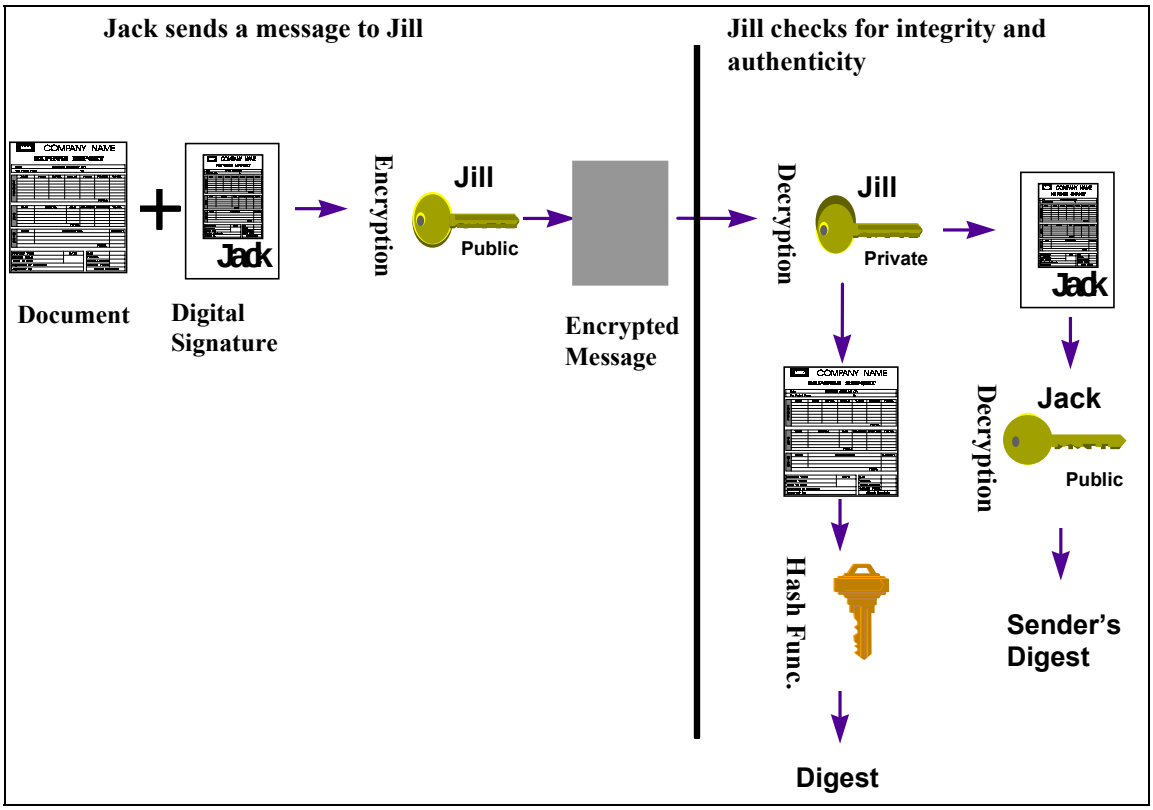

Figure 6. Authenticity and Integrity

Digital certificates are used to authenticate a person or organization by irrefutably associating them with a public key. A digital certificate contains information about the party that possesses it. The process of purchasing a digital certificate is similar to the process of obtaining a passport. The applicant must provide proof of identity along with their public key to the certification authority, the public half of a public/private key pair. The applicant's identification information, along with a list of privileges and available services, and the applicant's public key are included in the certificate. Figure 7 shows the basic contents of a digital certificate. When a certification authority issues a digital certificate to the requesting party, the certificate can be encrypted using the certification authority's private key. In this case, anyone who receives the encrypted certificate can decrypt it using the CA's public key and extracting the sender's public key.

Name:	Jill Jones
Address:	1450 Scalp Avenue Johnstown, PA
SS Number:	12-3456-7
Privileges:	ZZZ Bank Account #1234 YYY Credit Union #4321 QQQ ISP services
Public Crypto Key:	1234564321
Certification Authority:	Certificates R-Us
Certificates R-Us generated digital signature of Jill's digital certificate.	

Figure 7. Jill's Digital Certificate

A common method for providing authentication of the certificate and its contents is for the CA to include the digital signature with the certificate. When the recipient receives a message, the certificate is extracted and the digest is generated. The recipient also decrypts the CA's digital signature of the certificate using the CA's public key to yield the digest of the certificate created by the CA. The recipient then compares these two digests. If they are equivalent, the certificate is authentic, the sender's identity is authenticated, and their public key is extracted from the certificate.

Whenever an individual digitally signs a document, this digital certificate is included along with the message. The receiver of the message extracts the digital certificate and verifies its authenticity as previously described. If the certificate is authentic, then the receiver of the message extracts the sender's public key from the certificate. The recipient can now decrypt any message that has been encrypted using the sender's private key, since the sender's public key has been extracted from the certificate. The recipient can also be sure, as guaranteed by the CA, that this public key belongs to the party identified on the certificate.

The effectiveness of certification authorities are based on trust. Trust can be established using two different models of operation for CAs in the Public Key Infrastructure (PKI). One model uses a hierarchical structure for delegation of trust, and the other uses a network model to delegate the trust. In the hierarchical model, trust is delegated when a CA certifies a subordinate CA. This tree structure will grow to where trust can be transferred to higher level authorities in the infrastructure, eventually stopping at the Root Authority or Policy Approving Authority (PAA). The PAA functions as the single mutually trusted authority for the entire hierarchy. In the network model, trust is established between two CAs in a peer relationship.

Different CAs can enter into a mutual certification process called cross-certification. Cross-certification can occur between two PAAs in a hierarchical

model as shown in Figure 8. Each PAA countersigns the registered public key certificates of the other. In this example, if User 1 attempts to establish a secure relationship with User 2, authentication of each entities' identification is established by the hierarchy of trust, up to their certification path terminating at their respective PAA. The cross-certification between the two PAAs completes the link required for User 1 and User 2 to mutually authenticate their identities.

Cross-certification can also be established between two peer CAs in a network model as depicted in Figure 9. In this example, User 1 and User 2 authenticate their identities to each other through the cross-certification of their respective CAs. The network model opens up the possibility of the existence of multiple trust paths between any two CAs. In either model, once a common node in the certification path is identified, then a new trusted relationship is established between two entities.

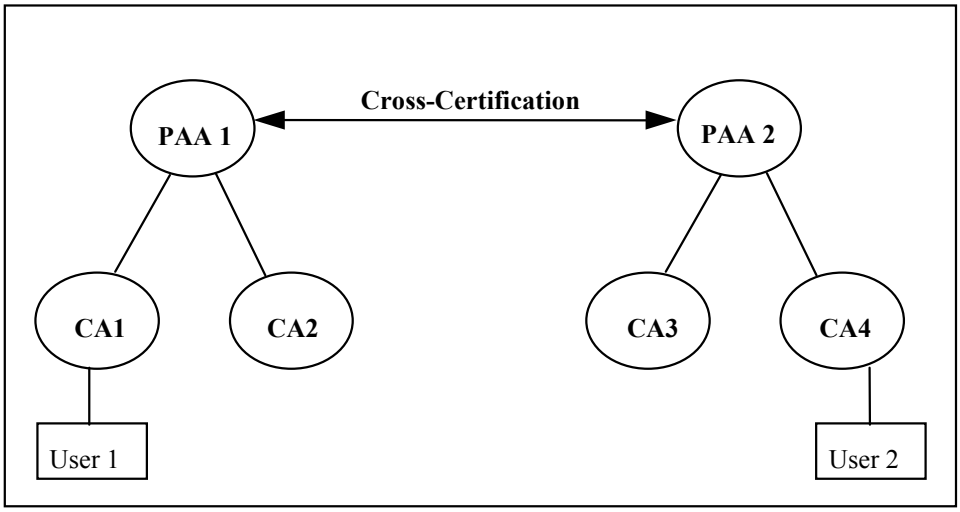

Figure 8. Hierarchical Cross-certification

Time stamping functions and affixing an accurate time to a transaction or event are used in conjunction with digital signatures and digital certificates to provide additional support for non-repudiation of transactions.

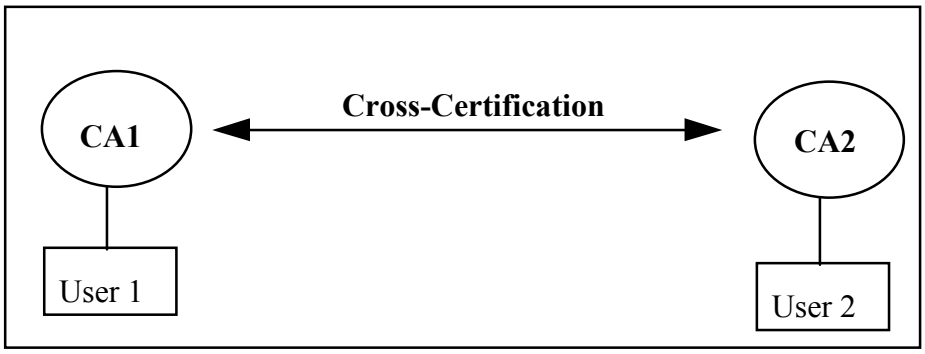

Figure 9. Network model for cross-certification

Secure Sockets Layer (SSL) and Secure Hypertext Transfer Protocol (S-HTTP)

Secure Sockets Layer (SSL) is a security protocol that uses cryptography to provide data security layered between application protocols, such as Hypertext Transfer Protocol (HTTP), File Transfer Protocol (FTP), Telnet, and the lower level Transmission Control Protocol/Internet Protocol (TCP/IP) protocols. SSL uses public key cryptography, server authentication, message integrity, and client authentication over a secured socket connection between two systems communicating over TCP/IP. SSL works through the process of the client (browser) and server negotiating a symmetric session key for the encryption/decryption of the packets. The messages are transferred between the client and server in an encrypted form. Decryption occurs after the message has been received. These session keys last for 90 seconds after which the client and server negotiate another session key. This process continues until the client/server link is disconnected.

The protocol "https" is a unique protocol that is HTTP running over SSL. It represents HTTP + SSL. The same server can run both "https" and HTTP. Therefore, it can provide both secured and unsecured information services.

The application level protocol, S-HTTP, is different than "https" and SSL. S-HTTP adds message-based security to HTTP and provides general purpose electronic commerce required, transaction-based security functions such as confidentiality, authentication, integrity, and non-repudiation of message origin. The development of S-HTTP was backed by the CommerceNet Consortium and Terisa Systems.

Disaster Recovery and Evaluation

Periodic execution and evaluation of the disaster recovery plan should be performed A process improvement plan should be established to maximize the effectiveness of the disaster recovery process.

Regular and thorough information/data backups must be done. The back up plans need to be part of the overall disaster recovery plan. Secure off-site storage and rapid, easy retrieval must be included.

Firewalls

Firewalls are used to prevent unauthorized access to network-based computer systems. There are two basic types of firewalls—routers and proxy servers. Firewalls can be used to filter unwanted packet traffic attempting to enter into the information systems network from the Internet and also can prohibit specific types of packets to be transferred from within the information systems network to the Internet.

Firewalls can also play a key role in providing partitioning functions on the enterprise's internal network. If security is compromised on a section of the network, a firewall could limit the spread of the security breech by restricting the problem to the original section. The more effective architectures for firewall protection are to use a combination of routers and proxy servers. A typical effective firewall architecture is the screened subnet architecture as depicted in Figure 10. This architecture features a bastion host that runs the proxy services and two routers. The exterior router serves as the interface filter between the outside world, or Internet, and the perimeter network. The interior router serves as the filtering interface between the perimeter network and the internal network.

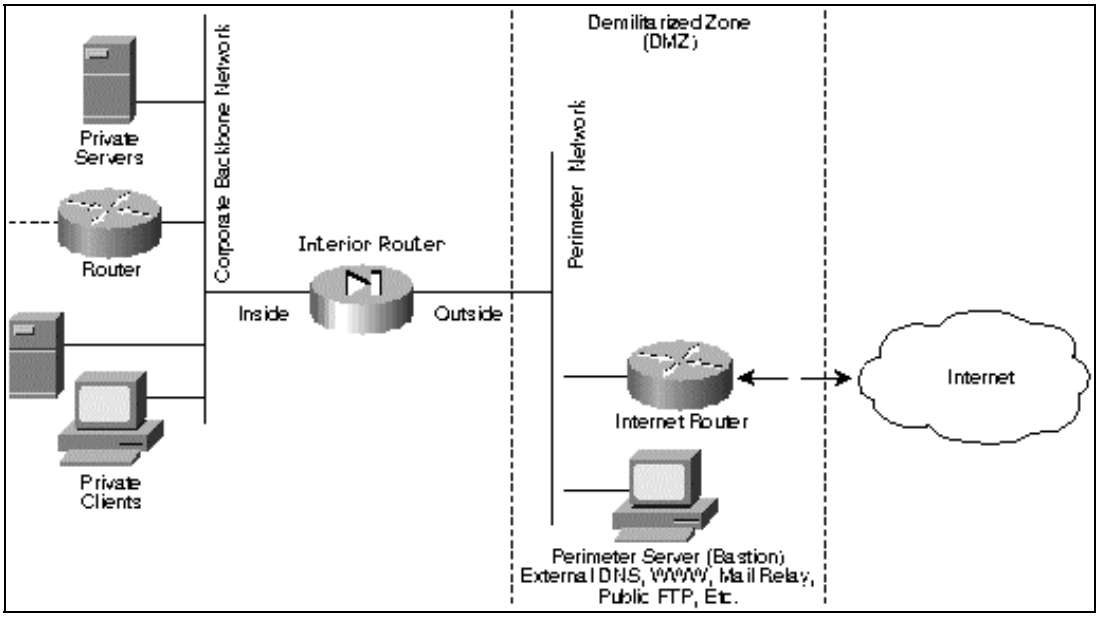

Figure 10. Screened Subnet Firewall Architecture

The National Computer Security Association (NCSA) evaluates and certifies commercially available firewall products. Table 19 lists some products that have passed the NCSA evaluation tests and earned an NCSA certificate. (*This*

information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service.)

Table 19. Examples of NCSA Certified Firewalls

Company	Product	Features	Cost
3Com	NETBuilder Router v9.1	Router software that runs on a wide range of router hardware.	$1,500 - $2,995
Cisco Systems	PIX Firewall	Hardware/Software solution. Prices depend on the number of simultaneous sessions allowed.	$ 9,000 small $16,000 medium $22,000 large
	Centri Firewall, v.3.1	Software solution.	$ 3,495, 100 users, $ 4,995, 250 users, $ 7,495, unlimited
CyberGuard Corp.	CyberGuard Firewall v2.2.3	Secure operating system (UnixWare) must be ordered along with the firewall.	$ 5,995, 50 users, ($ 1995 UnixWare) $ 9,995, up to 250, ($ 2495 UnixWare) $14,495, unlimited, ($ 2995 UnixWare)
Digital Equipment Corp. (DEC)	AltaVista (UNIX)	Works on systems with Digital Equipment Corporation's UNIX.	$ 3995, 50 nodes $ 7995, up to 250 $14995, unlimited
	AltaVista (NT)		$ 3995, 50 nodes $ 7995, up to 250 $14995, unlimited
IBM	Firewall, Version 3.1	IBM RS/6000 workstation with AIX Version 4.1.5 or 4.2.	$ 4,500 small $ 9,500 medium $16,500 unlimited
ON Technology Corporation	ON Guard	Windows and Intel architectures, support for IP and IPX.	$ 1,695 - up
Raptor Systems, Inc.	Eagle 4.0 (Solaris)	UNIX based systems.	$ 7000, 1-100 users $15,000 up to 250 $25,000 unlimited
	Eagle NT	Windows NT based systems	$ 6500, 1-100 users $11,000 up to 250 $15,000 unlimited

Anti-virus Software

The term virus in this context refers to all external code-based software entities that, when introduced into a computer system, can inflict damage to a computer's performance or the information it stores. This includes code-based entities classified under names such as Trojan horses, time bombs, trap doors, and viruses. There are four modes of infection for common viruses. They may infect files, infect the boot sector of a disk, target both files and boot sectors (multi-partite viruses), and affect documents through application macros.

Viruses that infect files can only appear in executable files. They primarily infect *.COM and *.EXE files. These viruses only become active when the file is executed. Boot sector infectors reside in the boot sector of a floppy disk or the Master Boot Record (MBR) of a hard disk. They are activated when the computer is booted. Macro viruses are currently found to affect documents written in Microsoft Word programs. These viruses are spread by opening an infected document. The NORMAL.DOT template becomes infected and all documents opened or created become infected.

Virus detection and elimination software needs to be running on all systems that can have files copied to its memory or disks from sources external to the enterprise, such as the Internet. This includes systems with network connectivity beyond the firewall and systems that can copy files from disks in internal floppy disk devices. The NCSA certifies products that detect and eliminate viruses. Table 20 contains the some of the latest virus elimination software that has been certified by NCSA. (*This information is based on CTC research, and does not constitute an endorsement by the EPA of any product or service*.)

Table 20. Examples of NCSA Certified Virus Protection Software

Company	Product	Features	Cost
Cheyenne	InocuLAN - Windows 95	Windows 95	$ 69 single client
	InocuLAN - Windows NT	Windows NT	$ 495 single server $ 69 single client
	InocuLAN for NetWare	NetWare	$ 495 single server
Command	F-PROT Professional	DOS, Windows 3.x, Windows 95, Windows NT, NetWare	$ 170 single user $ 1,250 for 25 users
Dr. Solomon's Software Intl.	Dr. Solomon's AntiVirus	Toolkit for DOS, Toolkit for Windows 3.x, Toolkit for Windows 95, Toolkit for Windows NT	$ 50 single user
	Dr. Solomon's AntiVirus	Toolkit for NetWare	$ 200 - 300
	Dr. Solomon's AntiVirus	Toolkit for OS/2	$ 70 - 75
EliaShim	ViruSafe for Windows 95	Windows 95	$ 99 single user $ 620 enterprise
IBM	AntiVirus	DOS, Windows 3,x, Windows 95, NetWare, OS/2	$ 45 per desktop
Intel	LANDesk Virus Protect	Windows NT	$ 30 single client $495 single server no clients $1,495 single server unlimited clients
	LANDesk Virus Protect	NetWare	$1,495 single server
McAfee	NetShield	Windows NT	$ 20 single license $190 for 10 nodes
	NetShield	NetWare	$ 20 single license $190 for 10 nodes
	VirusScan	DOS, Windows 3.x, Windows 95, Windows NT, OS/2	$ 50 to $65
Symantec	Norton AntiVirus for DOS	DOS, Windows 3.x, Windows 95, Windows NT	$ 79.95
Trend Micro Inc.	PCcillin for DOS	DOS, Windows 3.x, Windows 95, Windows NT	$ 50.00

Role-Based Access Control

Role-based access control (RBAC) grants access to resources and services to individuals based on their role in the enterprise. Users can be made members of roles as determined by their responsibilities and duties. RBAC streamlines the process of security management and enforcement. RBAC technology is beginning to emerge, and certain features have appeared in some products. The Common Object Request Broker Architecture (CORBA) Security specification uses RBAC as an access control mechanism that can be used with distributed object technology.

Biometrics

Biometrics is the use of technology to recognize and authenticate a person based on a distinguishing personal trait. Typical biometric applications use distinguishing traits such as fingerprints, voice recognition, or retinal patterns to identify a person. Fingerprint identification systems now exist. A commercial vendor offering a fingerprint biometric-based security system is Mytec Technologies. Biometric information encoded into smart cards is an important emerging technology.

SET - Secure Electronic Transaction

SET is an industry protocol and standard for conducting secure electronic-based credit card transactions over open networks. SET is championed by companies such as MasterCard and VISA, and supported by Netscape, Microsoft, IBM, Terisa Systems, GTE, SAIC, and VeriSign. The SET protocol requires authentication of cardholder and merchant, confidentiality of information, integrity of data, and inter-operability across software and network providers.

Entrust Technologies will soon be selling the product Entrust/Manager that offers SET capability to its certificate-based security solution from a single Entrust-based PKI. This product is compliant with the SET 1.0 protocol, issues X.509 version 3 certificates, supports the PKIX-3 certificate management standard, and supports cross-certification with superior CA's in the SET hierarchy.

Smart cards

Smart cards provide authentication support by combining user specific knowledge of a password with information on the smart card. Typical card-based information is a random number that changes on a regular time basis, such as every 10 minutes. Each card follows a sequence that is known only by the card and the host computer. The user's name, password, and card sequence number are required to gain log-in access to a host computer. Smart cards are being made with a Central Processing Unit (CPU), Random Access Memory (RAM), Read Only Memory (ROM), Input/Output (I/O) capability, and a dedicated cryptographic processor.

The parallel development of smart card support and applications is occurring along with the development of smart cards. This effort includes support for card readers, special Application Programming Interfaces (APIs), other smart card based applications, and interfaces between smart cards and desk top computers. Development of this technology is being lead by the PC/SC Workgroup, a consortium of PC and smart-card vendors that includes Microsoft, Hewlett-Packard, and Oracle.

Fortezza card technology is a standard PCMCIA type II card used as part of the U.S. federal government's internal security systems. The card contains the Capstone chip which implements the Skipjack encryption algorithm, Digital Signature Algorithm (DSA), Key Exchange Algorithm (KEA), hashing function, time stamping services, and password management. It also has a battery-powered RAM for holding certificates and a 32K Electronically Erasable Programmable Read-only Memory (EEPROM).

Kerberos

Kerberos is an authentication program that is distributed as freeware by MIT. Kerberos uses the services of a Kerberos authentication server (AS). Users, service providers, and host computers, register keys with the AS. When a user attempts to login to a host, the host, user, and AS exchange information that use time stamps to help authenticate the user and the service provider.

SATAN, Crack, COPS, Gabriel

These tools enable operators to gain access to networks. In the hands of intruders or hackers, they can present a serious threat to the security of an information system. In the hands of skilled system administration personnel, they can be used to protect the information systems from intruders. Crack can be used to mount a dictionary file based password attack on a system. Computer Oracle and Password System (COPS) is used to analyze system configurations looking for security weaknesses. Security Administrator Tool for Analyzing Networks (SATAN) is a package of programs that probes hosts on a network from the outside looking for well known security weaknesses. Gabriel is a tool that will indicate if SATAN is being used to probe your system.

In addition to the threats and anti-threat products discussed here, other more traditional mechanisms must be used to ensure secure electronic commerce. These include time stamping, activity accounting, logging and recording, and auditing. These mechanisms ensure a reliable record is retained to aid in investigating and tracing security breaches.

4.9 Additional Information Systems Security Concerns

Additional ISS concerns exist that a comprehensive security policy and program should address.

Remote Access

Allowing users access to the information systems via remote access mechanisms opens another dimension to information systems network security concerns. All remote access must be channeled through a secure node that requires strong password authentication. Commercial products exist that support secure remote access.

Operating Systems Security Flaws

There are specific security flaws that exist in all operating systems that can be exploited to compromise the information system. There is a wealth of information available about security flaws and the appropriate steps to take to reduce security risks in a UNIX operating system. As Microsoft's Windows NT operating system gains more of the market share for Internet servers, additional security flaws have been discovered and exploited. Solutions to these security flaws are continuously being made.

Additional Internet and World Wide Web Concerns

Inherent security flaws in the infrastructure of the Internet and World Wide Web exist. For example, the source routing option in the Internet Protocol (IP) header can be exploited to penetrate firewalls on some systems. Security flaws have been exposed in two predominant Web application languages, Perl and Java. Improvements to the security of Java have been made and will continue to be made as threats and defects are identified.

Electronic Mail

The protocol for transmitting mail over the Internet is Simple Mail Transfer Protocol (SMTP). Multipurpose Internet Mail Extensions (MIME), allows information other than text to be sent in e-mail packets. Neither MIME nor SMTP mail is secure. Secure solutions for e-mail include the Internet standard Privacy Enhanced Mail (PEM) that provides authentication, confidentiality, non-repudiation of origin, and integrity of e-mail messages. Secure Multipurpose Internet Mail Extensions (S/MIME) provides PEM-type security for MIME type e-mail.

Commercial products exist such as Deskgate Technology's VIAexpress that allows users to include messages, Windows-based documents, and bit-mapped graphics into an electronic envelope that can be securely sent using e-mail. VIAexpress uses single key, password security with automatic file compression. The recipient may read of one of these e-mail packets without requiring any additional software.

The ANSI X.400 standards address the message handling standards. Security services addressed by X.400 include message security labeling, origin authentication, data integrity, data confidentiality, non-repudiation, and security management.

Application Level Security

Software applications also pose a threat to information systems security. There is no guarantee that COTS software applications and internally developed applications will maintain the integrity of data files and not significantly degrade the performance of key information systems services. These potential threats need to be evaluated and addressed as part of a ISS Program.

4.10 Information Systems Security Relevance to the EPA

Information systems security is a primary requirement to protect key EPA information, reports, and computer systems. Information must be secured at the site where it is stored and it must be secure during transfer between secured sites. All EPA sites that will be storing secure information or providing key services need to have an active information systems security program. This includes establishing a risk management program, creating a information systems security policy, implementing a disaster recovery plan, and providing security training for the security personnel and the user community at large.

Access control can be achieved through physical security methods, such as locking rooms that contain key equipment and information. Installing firewalls gives an added level of access control from external sources into your internal network. At the desktop level, screen savers and password protected systems add additional access control. Secure communication protocols, such as SSL, must be used when confidential information is transmitted. Confidentiality can be achieved through the use of cryptography. Virus detection and prevention software should be used on all systems that are capable of storing information or executing files that originate from external sources. Anti-virus software helps maintain information integrity and keeps information systems services operational.

The EPA has implemented many layers of security protection for its computer and information systems to combat the threats discussed in this section. These policies, procedures, and methods should continually be evaluated to take advantage of the latest advances in technology.

The most appropriate areas for the EPA to examine are authentication, non-repudiation, and information integrity. For electronic reporting use to grow, wider governmental and private sector acceptance of electronic security means is necessary and will come with time and improvements in technology. However,

currently available software products can assure the authenticity of authorship of a document and guarantee the integrity of its contents by using digital signatures to sign documents. The use of digital certificates issued by a certified CA, in conjunction with digital signatures, provides an even stronger mechanism for proving authentication and information integrity. This technology can be used to supplement or replace the EPA's current Personal Identification Number (PIN) system for authentication and integrity of electronic reports.

The security costs EPA and reporting organizations will incur are dependent on a careful analysis of EPA objectives and requirements. The costs will vary depending on the level and sophistication that is needed. The representative products cost tables indicate that a wide variety of affordable security products are presently available to address internal and external security threats to electronic commerce and reporting systems.

5.0 ELECTRONIC COMMERCE IMPLEMENTATION ASSISTANCE FOR TRADING PARTNERS

Successful electronic commerce and EDI initiatives frequently rely on providing assistance for trading partners as they learn and implement electronic commerce technologies. This is true in the federal government as well as the private sector. The DOD sponsors the National Electronic Commerce Resource Center (ECRC) Program for that purpose. The ECRC Program demonstrates a proven methodology for providing assistance to trading partners and promotes the expansion of the DOD's electronic commerce initiatives. The ECRC model can be used as a basic structure for a similar EPA program which can assist any organization with electronic reporting.

The federal government and industry are working together to leverage existing technologies and to develop new strategies and standards which will enable effective generation, exchange, and management of information. The combination of emerging electronic commerce technologies and the increased usage of EDI in day-to-day business processes have created an environment that focuses resources on areas that will enhance manufacturing productivity, reduce time to market, and improve quality at reduced cost. These concepts attack "business as usual" at all levels, from proposal solicitation to billing, and from product design to operational support in the product life cycle. These efforts are particularly important in a period of shrinking resources and increasing competition. The government cannot afford inefficiency in its own operations or in those of its suppliers. Electronic commerce technologies represent an unprecedented opportunity to fundamentally improve the way government agencies and industry conduct business.

Each day the DOD purchases goods and services from over 370,000 manufacturers and vendors across the United States. Over 98 percent of these purchases come from SMEs. In order for the DOD's procurement and acquisition functions to maximize its use of

electronic commerce, manufacturers and distributors need to adopt standards-based electronic commerce practices.

The ECRC Program's primary role has been to serve as the mechanism to promote the DOD's electronic commerce initiative and facilitate change through the implementation and application of electronic commerce and other emerging information technologies. It provides technical leadership and support to thousands of organizations that currently do business or are planning to do business with the DOD. The ECRC Program vision seeks to enable a virtual enterprise in which DOD suppliers collaborate and compete thus providing cost-effective products, supplies, and services. Since most large corporate organizations are already EDI capable, the ECRCs have targeted SMEs in an effort to enhance supplier/customer relationships and level the playing field. By putting to use electronic commerce technologies and applying concepts and best practices outlined by the ECRC Program, SMEs are better able to examine current operations and make decisions on future direction.

In order to achieve its mission, ECRC Program initiatives are framed around four strategic goals: (1) the identification and understanding of customer needs, (2) the driving of customer implementation of electronic commerce, (3) the evaluation, development, demonstration and transfer of electronic commerce technologies and, (4) the leveraging of existing resources and capabilities across other government agencies at the local, state and federal level and throughout private sector organizations. These initiatives are proactive and aggressive in the dissemination of electronic commerce and EDI information.

Since its inception in 1991, the ECRC Program has consistently re-evaluated and re-focused priorities to keep pace with technological advancements and changing customer needs. National outreach, education and training, and technical support are the core functions of the ECRC Program. Goals and objectives focus on providing products and services designed to engage organizations in the use of electronic commerce technologies. By knowing the adoption of these technologies is not easy for SMEs, the ECRCs can enable the transition through individual steps outlined in the core functions.

5.1 ECRC Program Organization and Management

The ECRC Program is led by the Deputy Under Secretary for Defense (Logistics) (DUSD(L)) intended to support tri-service needs. It is directed and managed by the Defense Logistics Agency (DLA) ECRC Program Office (EPO), located at Fort Belvoir, VA, on behalf of DUSD(L). Each center and the NECRC Technology Development Activity (TDA) is managed by a program manager who is empowered to lead in deployment of electronic commerce technologies. The Regional ECRCs are coordinated by a team integrator, who has cognizant authority over all centers and assures efficiency throughout the nation. This management approach has been highly successful. To date, over 70,000

commercial and government entities have received service from the ECRCs. Figure 11 illustrates the ECRC Organizational Model.

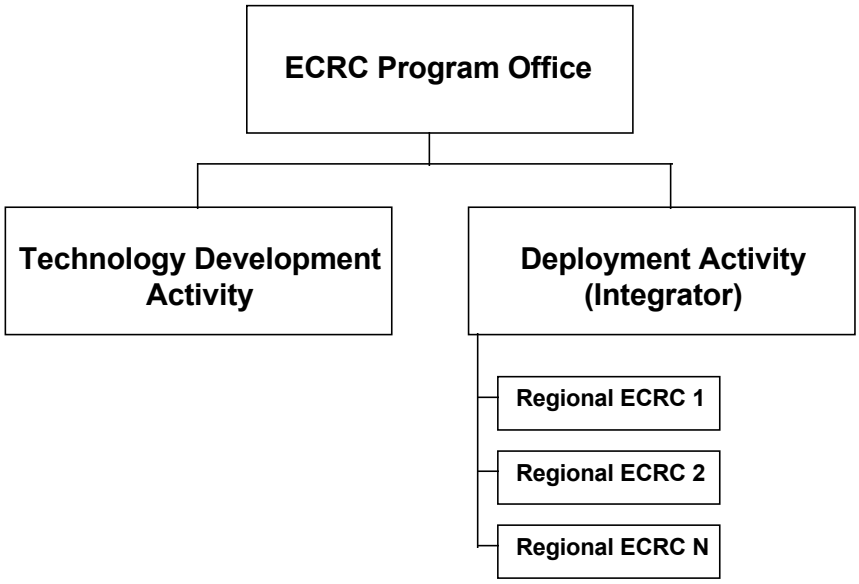

Figure 11. ECRC Organizational Model

ECRC Program Office (EPO): provides government oversight and direction of the ECRC Program.
Team Integrator: coordinates and leads the activities of the Regional ECRCs.
Regional ECRCs: serve as the deployment arm of the ECRC Program by providing three major activities; outreach, education and training, and technical support.
Technology Development Activity (TDA): responsible for understanding existing and emerging electronic commerce technologies, standards and practices. The TDA develops and demonstrates new electronic commerce technologies, filling the gaps which are not addressed by software vendors.

A total of seventeen Regional ECRCs (see Figure 12) serve as the deployment arm for the information technology and tools that enable electronic commerce and enterprise integration for business and government.

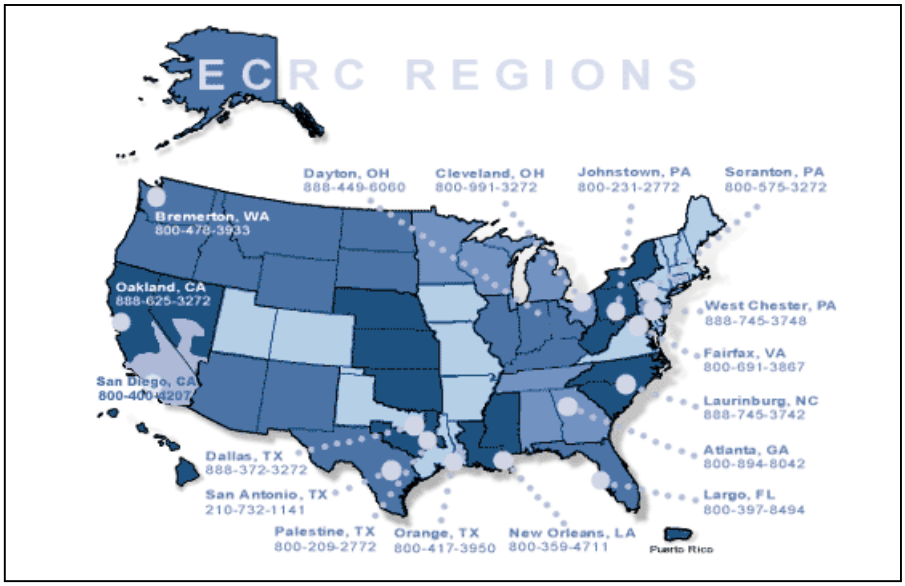

Figure 12. Regional ECRC Distribution

The National ECRC is a carefully orchestrated coordination of outreach, technical support and educational activities. The individual ECRC core functions are not stand alone activities. Each core function has been designed to complement the other, so that when combined, they provide a suite of capabilities. The intent of these capabilities is to be "event driven," where each function is designed to identify and prepare ECRC customers to provide the DOD and other related industries the opportunity for face-to-face interaction with electronic commerce literate technical staff. The interaction of each is depicted in Figure 13.

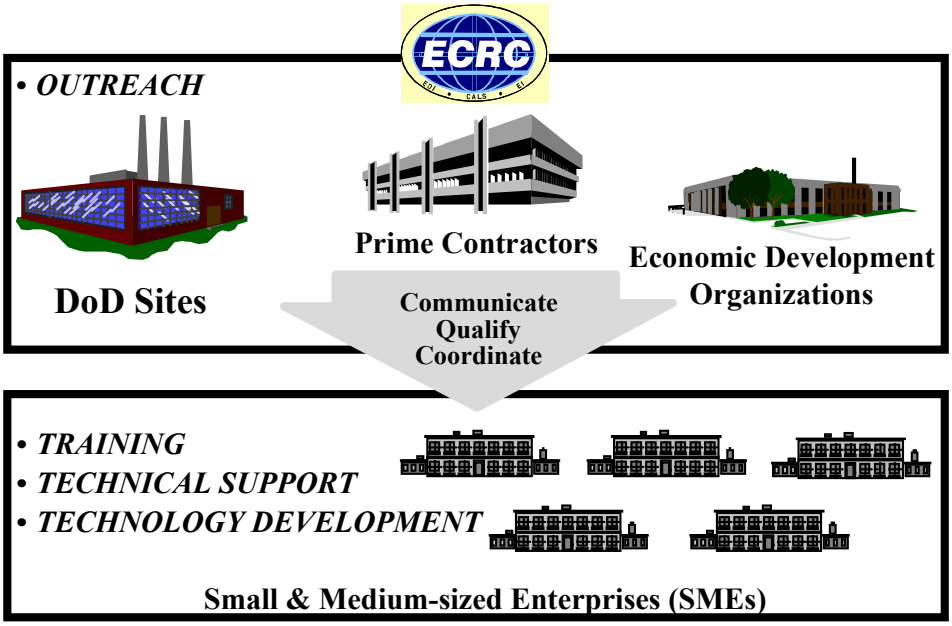

Figure 13. ECRC Implementation Model

5.2 ECRC Methodology

Electronic commerce can significantly improve an organization's efficiency and effectiveness. Abruptly changing from manual methods without the proper education and training, technical support and consultation has proven to be counterproductive. Therefore, the ECRC Program provides a menu of services to expedite the integration of electronic commerce by the U.S. civil-military industrial base. These services are described in the sections below.

5.2.1 Outreach

The Outreach function centers on leveraging pre-existing activities to demonstrate the greatest impact on their constituents, such as prime contractors, DOD contracting activities, and economic development organizations. Working with these organizations, the Regional ECRCs conduct proactive dissemination of electronic commerce-related information to DOD and industry. An outreach event is described as any activity initiated by the ECRC that results in the purposeful display, demonstration or presentation of electronic commerce information.

The ECRC Program, through the Regional ECRCs, will disseminate electronic commerce philosophy, standards and specifications, as well as information on enabling emergent technologies for government and industry. Outreach activities are multifaceted and include trade shows, conferences, seminars, demonstrations, and presentations. In addition to these activities, the interaction between Regional ECRCs is imperative to the success of the program. Newsletters and brochures containing information on current developments in electronic commerce standards, enabling technologies, upcoming and related events, and shared information help promote the ECRC Program's growth.

5.2.2 Education and Training

The interaction of outreach and technical support drives the need for electronic commerce education and training. ECRCs deliver training courses in electronic commerce and EDI to SMEs, government procurement offices, and other customers. The main objective is to build understanding and competency when implementing electronic commerce and emerging technologies into their environments.

A wide range of training capabilities must be available through the ECRC Program to properly educate and train the customer base. Electronic commerce and specialized technology training are critical to the success of the ECRC Program. Education and training activities, which are directed

by the ECRC team Integrator, include planning, design, development, and deployment to both government and industry. Related activities also include the identification and development of new subjects, planning of their deployment, maintenance of new and existent training materials, as well as all associated management tasks. The ECRCs leverage other established training programs that focus on electronic commerce enabling technologies, making sure that all training initiatives are not redundant.

The courses below are representative of the current ECRC catalog. The knowledge resident within the courses and developers can easily be tailored to specific needs.

- Business Needs Analysis
- Business Opportunities with the DOD through EDI
- CALS and Integrated Manufacturing
- Concurrent Engineering
- Data in a Business Environment
- EDI Orientation
- EDI Software Characteristics
- Electronic Commerce for Government Acquisition
- Electronic Commerce Hardware and Software Requirements
- Geographic Information Systems (GIS)
- Getting Started with Electronic Commerce
- Issues in EDI Implementation
- Legacy Data Management
- Recovering Design Data
- Standard Generalized Markup Language (SGML)
- Technical Data Interchange
- The Internet Electronic Commerce Series

5.2.3 Technical Support

Where an outreach event helps to identify electronic commerce needs, a technical support event is the interaction between the ECRC and a customer based upon a clearly identified problem. The individual ECRCs receive candidate technology issues and problems suitable for evaluation, study, analysis, and demonstration from the customers. Most technical support events begin with a consultation between an ECRC and a customer that focuses on problem identification. The technical support continues toward solution development, which may include business process re-engineering, off-the-shelf technology application and integration, recommendation for training, and legacy data conversion. In some cases, a detailed Business Case Analysis (BCA) may be developed. BCAs provide key management information and are a decision making tool. The BCA addresses both economic and functional issues which

contain sufficient detailed information to allow the program integrators to make focused decisions regarding priority, funding, and technical development.

5.2.4 Performance Measures and Quality Improvements

Effective operation of the ECRC Program is facilitated and monitored by each center, the integrator, and the DOD Program Office. Goal-setting, performance monitoring, continuous improvement, and most importantly, benefit to the client community are the purpose of having discrete performance measures. Management tools, such as the Annual Management Plan and Quarterly and Final Reports articulate these goals and performance measures to staff and other interested personnel. The NECRC Program continues to develop and revise a set of activity and intent-based metrics designed to facilitate appropriate service delivery and provide for performance evaluation and continuous quality improvement. The following sections outline these metrics.

5.2.5 Activity-based Metrics

These metrics account for engagements with client companies and depict service levels provided. They are taken directly from the regional ECRC database, and correlate with services provided under each of the ECRC core functions. Representative examples include:

- Outreach - activities undertaken and organizations contacted
- Education & Training - organizations and individuals trained, and classes delivered
- Technical Support - technical support provided to organizations.

5.2.6 Intent-based Metrics

Intent-based metrics are more difficult to measure than activity-based metrics. However, answers to the following questions are key indicators as to the success of the program and are captured through follow-up surveys and documentation of success stories.

- Did the ECRC Program assist an organization in advancing its electronic commerce capability?
- Did the Regional ECRC or TDA provide its customers with satisfactory service?
- Did the U.S. taxpayer receive an equitable return on its investment?

These questions are addressed by conducting customer surveys, documenting success stories, consolidating metrics from all Regional ECRCs, and by auditing conducted by the DLA and other government organizations.

5.3 ECRC Program Success Stories

The ECRC Program has developed many success stories since its inception. The following success stories represent each class of ECRC customer: a DOD organization, a prime contractor, and an SME.

5.3.1 Surface Ship Torpedo Defense (SSTD) Program (DOD Organization)

Based upon a mutual need to defend surface ships against enemy torpedoes the governments of the United States (US) and United Kingdom (UK) entered into a collaborative program to design, develop, test, and procure a Surface Ship Torpedo Defense (SSTD) system. An agreement between the US and UK was initiated which established a US/UK SSTD Joint Program. In June 1994, members of the SSTD Program Office (PMS427), under the United States Navy Program Executive Office (PEO) for Undersea Warfare approached the ECRC Program for assistance in implementing electronic commerce throughout the SSTD acquisition program. The PEO wished to implement electronic commerce to achieve the Naval Sea Systems Command (NAVSEA) objective of streamlined acquisition processes and to satisfy the requirements of the Federal Acquisition and Streamlining Act (FASA). Based on their expertise, the ECRC was selected to provide electronic commerce consultation and technical support to the SSTD Program Office in their electronic commerce implementation efforts.

The goal of the SSTD Program Office was to conduct all program-related technical and business transactions using electronic commerce. To ensure an orderly transition from the original manual mode of program operation, the SSTD Program Office developed an electronic commerce implementation plan (ECIP) with the assistance of the ECRC Program. The ECIP focused on implementing electronic commerce in all tiers of the supplier chain. The plan addressed the electronic exchange of program documents including deliverables, progress reports, business documents, correspondence, presentations, engineering drawings, and financial documents. Standards and technologies were implemented in a phased approach over the life cycle of the project. Implementation is incremental with electronic commerce technologies being progressively integrated into the overall program. The primary value of electronic commerce capability for the SSTD Program was the establishment of enhanced capabilities

early on in the project to create a foundation for providing the maximum return on investment.

The full implementation of electronic commerce into the Navy's acquisition program will result in efficiencies and quality advantages similar to those realized by commercial industry. The Navy expects these programs to experience better engineering designs through the use of concurrent engineering and simulations, more efficient manufacturing processes through increased use of electronic technical data transfer and just in time supply of components, reduced rework, and better communication between the Program Office, prime contractors and suppliers. Some additional benefits that are expected are shorter acquisition cycles, decreased unit cost, increased quality, increased operational readiness, longer in-service life, reduced manning requirements, and reduced maintenance and material management requirements.

ECRC Objective

Assist in the implementation of electronic commerce throughout the SSTD weapon development and acquisition program.

ECRC Actions

- Designed and conducted surveys and interviews to support analysis of SSTD Program information processes
- Provided technical and business guidance to the SSTD Program
- Prepared an electronic commerce implementation plan.

Results

- Electronic commerce began changing the SSTD Program's method of doing business from predominantly paper-based to an electronic-based exchange of business and technical information.
- The electronic commerce technologies and supporting information technology enhancements implemented include e-mail, electronic development and routing of technical and administrative documents, and classified and unclassified local area networks.
- Middle and far term electronic commerce objectives include EDI and concurrent engineering. Follow-on efforts will be directed at continuing the penetration of electronic commerce through all levels of the supplier chain and adding other electronic commerce technologies.
- The primary benefits obtained from the electronic commerce implementation include availability of better management information, development of a better weapons system for the DOD, reduced design

time and process, reduced operating and administrative costs, improved collaborative engineering, and reduced transaction times.
- Given the successful implementation of electronic commerce, it is expected that additional interest in more joint/combined defense acquisition programs will emerge.

5.3.2 Harley-Davidson (Prime Contractor)

In 1992, Harley-Davidson, an American motorcycle company and DOD supplier, found itself in the enviable position of being asked to produce more motorcycles. Harley-Davidson's plant in York, Pennsylvania, is the only Harley-Davidson facility where four hundred fully assembled, ready-to-ride bikes are produced per day. An estimated 2,000 people are employed by the plant, working three shifts. To support this continued growth, Harley-Davidson needed to find ways to better serve the American marketplace and remain competitive on the global playing field. Harley-Davidson is the only American company which competes with foreign companies like Suzuki and Kawasaki. The company's response to the rising demand for motorcycles and the pressure of global competition was to adopt electronic commerce, specifically just-in-time inventory practices and EDI. Harley-Davidson's goal was to streamline processes in both plant production and systems, improve material flow, and minimize inventory. Achieving this goal will require relying heavily on the cooperation of all 200 Harley-Davidson's suppliers.

Rather than just ordering its suppliers to do EDI, Harley-Davidson took a helping hand approach. Harley-Davidson began by hosting a vendor conference where plans for EDI implementation were discussed with suppliers, and options for coming on-line were presented. After Harley-Davidson's initial efforts, they realized that they would need assistance and sought consultation from the ECRC Program. Harley-Davidson is a DOD prime contractor for Navy rocket engines and police motorcycles and fit within the ECRC Program goals and objectives.

The ECRC began by conducting a customer needs assessment to scope out the magnitude of the implementation effort. It was clear that suppliers fell along different points on the electronic commerce migration model. Many suppliers were small businesses without automation or computer capabilities, while others were EDI capable but still required assistance integrating challenging new transaction sets. Based on this assessment, a comprehensive implementation program was designed by the ECRC for Harley-Davidson.

The ECRC successfully assisted Harley-Davidson in the implementation of electronic commerce across the supply chain and later participated as a

consultant in management planning efforts to implement EDI internally throughout the Harley-Davidson Corporation.

ECRC Objective

Implement EDI across Harley-Davidson's supply chain.

ECRC Actions

- Ongoing resource for Harley-Davidson and its suppliers
- EDI implementation plan for supply chain
- EDI implementation plan for internal use
- Introductory courses on PC computing
- Customized EDI education and training courses
- Training on ANSI X12 830 (Planning Schedule) and 856 Transaction Set (Advance Ship Notice)
- Legacy data management courses.

Results

- As of November 1996, 76 percent of Harley-Davidson's suppliers are receiving transaction set 830 (Planning Schedule with Release Capability) via EDI. This accounts for 85 percent of Harley-Davidson's production parts.
- With EDI implementation, Harley-Davidson was able to increase production at its York, Pa. facility to over 100,000 units annually, two years ahead of schedule with no increase in plant size or in the number of employees.
- Harley-Davidson's in-plant inventory has dropped from 12 to 6 days.

5.3.3 J.J. Nita Burgoon Company (Small to Medium-Sized Enterprise)

J.J. Nita Burgoon Company, a small medical supplies company, contacted the ECRC Program in early 1995 after a series of setbacks. Sales for 1994 dropped to $500,000, the staff was reduced and growth prospects for 1995 were grim. Burgoon realized that they were continually being cut from the government procurement loop. Its biggest customer, the federal government, relied more and more on EDI to conduct business. Then, in January 1995, Lockheed-Fort Worth company, a DOD contractor and a major customer, informed Burgoon that unless it received bids via EDI, they could no longer buy from Burgoon.

Burgoon turned to the local Small Business Development Center, where a counselor recommended the ECRC Program.

ECRC Objective

Implement EDI at Burgoon.

ECRC Actions

- Introductory and advanced courseware in electronic commerce and EDI
- EDI implementation plan
- Technical support and consultation.

Results

- Burgoon recaptured old customers, including Lockheed-Fort Worth and added new ones.
- Burgoon now receives two-thirds of its business electronically.
- Electronic commerce enabled Burgoon to respond quickly to Request for Quotes (RFQ), determine points-of-contact in purchasing departments, and gather information about potential sales via the Internet.
- Burgoon receives timely and accurate updates by relying on electronic access to catalogs and material safety data.
- Burgoon is now a global company. It operates its own Web site and receives requests for products throughout the United States, as well as from Norway and Finland.
- Burgoon is now viewed as a major player equal in visibility to major corporations.
- Sales increased to $1.1 million.
- Burgoon wins 25 percent of the RFQs on which it bids and projects $2.5 million in awards 1997.

5.3.4 Success Story Summary and Lessons Learned

The ECRC Program has had a positive impact, not only with its primary target group, the SMEs, but also with large enterprises and programs within the sponsoring agency. The ECRC Program is a valuable asset for increasing the DOD use of electronic commerce and will continue to be as electronic commerce technology evolves.

The National ECRC Program has provided outreach, training and technical support services to thousands of U.S. industrial, government, and academic organizations. In addition, the ECRC Program assists the DOD in keeping abreast of the latest developments in electronic commerce technologies and using those technologies in a timely and efficient manner. Throughout the development and maturation of the

ECRC Program, the DOD and the ECRC Program have learned many lessons, along with the most effective method of providing trading partner electronic commerce support, including:

Outreach

- Leverage organizations having large influence or control over their supply chains.
- Work with large supply chain leaders to develop processes and methods to elicit behavioral change in their suppliers.

Education & Training

- Leverage as much off-the-shelf courseware as possible, as electronic commerce vendors develop product-specific training solutions on an ongoing basis.
- Utilize a team approach by use of effective trainers teamed with technical and business experts in courseware delivery.
- Courseware development must be an agile process as technology evolves.

Technical Support

- Utilize off-the-shelf products and integrated solutions as much as possible; emphasize standards-based (non-proprietary) solutions.
- Solve problems over the phone by staff having technical expertise in the domains of the recipient companies.

Technical Development

- Focus on integrated solutions that are usable by a large audience.
- Work with industrial and government partners having experience in emerging technologies.

Deployment Program Management

- Use a single integrator as program manager for diverse sites.
- Empower regional site managers to take ownership and build relationships in deployment and development activities.

5.4 ECRC Program Applicability to the EPA

The ECRC Program has been a "knowledge navigator" and an essential force in the implementation of electronic commerce for the DOD. This includes consultation and technical recommendations, identification of current electronic commerce capabilities, examination of current administrative and operational processes and procedures, and analysis of current and future information management requirements. From these experiences, the ECRC Program has gained knowledge and insight into the problems facing many public and governmental organizations.

Electronic commerce has emerged in different manners across different government and industry sectors. Although some sectors have been more innovative than others in integrating information technologies, most have faced similar problems. The EPA has not received the full benefits and return on investment (ROI) from electronic commerce despite having electronic commerce and EDI initiatives underway for several years. Future benefits and ROI will depend heavily upon the private sector's knowledge, understanding, and use of EPA electronic reporting processes and procedures. The ECRC Program paradigm can be applied to assist the EPA in increasing public awareness, acceptance, and utilization of EPA electronic reporting methods. In addition, a program similar to the ECRC Program can provide the EPA with up-to-date information on new and evolving electronic commerce technologies, develop innovative solutions to leverage available technology for maximum EPA advantage, and keep the EPA on the forefront of federal government electronic commerce and paperwork reduction efforts.

5.5 Other Electronic Commerce Assistance Programs

In the United States, the national standards for EDI are developed and customized for business and industry sectors primarily by trade, technical, professional, consumer, and labor organizations. Although the National ECRC Program is unique in nature by providing electronic commerce education, consultation, and technical support, there are many other sources of assistance for organizations that are implementing electronic commerce. In addition, many large commercial businesses, such as R.J.R. Nabisco and Mobil Oil, have increased their electronic commerce benefits by assisting their trading partners in becoming electronic

commerce capable through educational, financial, and technical support incentives. Many industry associations and standards developing organizations for electronic commerce and EDI are listed below and can be helpful in electronic commerce initiatives.

Automotive Industry Action Group (AIAG) - a not-for-profit trade association of North American vehicle manufacturers and suppliers. The mission of the AIAG is to improve the global productivity of its members and the North American automotive industry. This organization encourages cooperation and communication between trading partners and their suppliers to improve business processes while addressing existing and emerging common issues and apply new technology to increase the efficiency of the industry.

American National Standards Institute (ANSI) - ANSI is a private, not-for-profit membership organization that coordinates the U.S. voluntary consensus standards system and approves American National Standards. The Accredited Standards Committee (ASC) X12 of ANSI develops uniform standards for inter-industry electronic interchange of business transactions within the United States.

The BT EDI Research Centre - established in 1987, at the Department of Maritime Studies and International Transport to foster the development and implementation of EDI within the logistics, distribution, and transportation industries. Funded by British Telecommunications, the Centre has played an active role in developing and promoting EDI standards for short sea, deep sea and seaports in collaboration with the EDI Association (UK) and the Western European EDIFACT Board.

Center for Electronic Commerce (CEC)- provides solutions for business partners to improve supply chain integration from the Industrial Technology Institute, Ann Arbor, Michigan. The CEC develops, tests and pilots integration methods and tools for best practice in order to assure successful integration of supply chains.

Common Industry Material Identification Standards (CIMIS) - develops a catalog of common material descriptions for the Petroleum and Construction industries.

Data Interchange Standards Association (DISA), Inc. was formed in 1987 to be the secretariat for the ASC X12 committee.

United Nations rules for Electronic Data Interchange For Administration, Commerce and Transport (UN/EDIFACT). The worldwide EDI standards setting organization.

Electronic Commerce Association (ECA) - a non-profit organization established to advance electronic commerce and business use of technology in Canada.

Electronic Commerce World Institute - a consolidated international source of information and resources on electronic data interchange and electronic commerce, including publications, case studies, news, events, products and services, Internet resources, virtual exhibits, and directories of EDI/EC organizations around the world. There is a beginner's corner with a Road Map to EDI, as well as information on the Electronic Commerce World Institute and its members.

IndustryNET - established in 1991, to provide electronic methods to automate the buying and selling process for industry. IndustryNet has several products and services including, IndustryNet Report, the IndustryNet On-line Marketplace, the IndustryNet Regional Buying Guide (a computer-based industrial buying guide), and the IndustryNet Continuing Education Group.

International Organization for Standardization (ISO) - a worldwide federation of national standards bodies from some 100 countries, one from each country. The mission of ISO is to promote the development of standardization and related activities in the world, with a view to facilitating the international exchange of goods and services.

National Association of Purchasing Managers (NAPM) - a national organization providing information and education for people involved in purchasing and procurement. Many chapters have opened across the country, and one of the most active in promoting Internet-based Electronic Commerce is the Silicon Valley chapter.

Petroleum Industry Data Exchange (PIDX) - A petroleum industry organization sponsored by the American Petroleum Institute (API) that promotes and supports electronic commerce use and standards for the petroleum industry.

South Carolina Research Authority (SCRA) A state organization with experience in designing, developing, implementing, and supporting software tools that address the concepts and principles of electronic commerce, SCRA offers BIDQuest, a software tool that prepares and issues Requests for Quotes (RFQs), and BIDPrep, a recursive bidding software tool that receives EDI ANSI X12 standard RFQs, delegates requests for bid information to all levels within an organization, summarizes the information into a bid, and electronically transmits the bid as an EDI ANSI X12 standard bid back to the requesting party.

6.0 CONCLUSION

The EPA has been conducting EDI initiatives in various areas of compliance reporting as part of a plan to reduce its internal and external reliance on paper documents. Progress has been slow for the EPA. Cultural acceptance, cost, and lack of information about the benefits to be gained are some of the reasons for this delay. However, electronic

commerce will continue to grow and play a key role in paper reduction efforts as part of a long-term federal strategy.

Since the 1970s, many private and government entities have reaped the awards of electronic commerce, particularly EDI. In addition to quantifying the costs and benefits associated with electronic commerce, this analysis examined the motivation of organizations which use electronic commerce. Although many potential EPA trading partners are already EDI capable because of their size, studies show that many organizations implement electronic commerce solutions only to meet a requirement by a trading partner and not because they see a benefit for their organization. However, once mandated to implement electronic commerce, many organizations realized the "win-win" scenario of electronic commerce. An electronic reporting mandate issued by the EPA will accelerate the benefits the EPA will receive. Given that the EPA is not requiring the regulated community to use electronic commerce due to public perception issues, awareness and marketing of EPA electronic commerce initiatives is imperative to the success of EPA electronic reporting. Using the ECRC Program model will enable the EPA to increase awareness of electronic reporting initiatives, provide education to trading partners in both current and emerging electronic commerce technologies, and furnish consultation and technical support to assist organizations implement electronic commerce solutions.

Another key ingredient for success of electronic commerce programs is to use new and evolving technologies such as Internet-based reporting to reach out to the greatest number of trading partners. Simple, low-cost, easy-to-use solutions will greatly enhance the private sector's participation in electronic reporting. This is particularly true of small organizations which represent a large number of report submissions to EPA, even though one SMEs reporting frequency and volume may be low. The Internet approach discussed in this document is similar in nature to working systems which the ECRC Program TDA has deployed for several DOD organizations and facilities.

Although this analysis demonstrates a clear business case for electronic commerce implementation in a wide cross section of government and private organizations, electronic commerce is just one tool in re-engineering the methods EPA and the regulated community do business. Any strategy should be revisited and revised as necessary as technologies and standards evolve. Failure to adjust policies and strategies or plugging in electronic commerce solutions without re-engineering processes will reduce and delay the benefits of electronic commerce use.

The EPA needs to consider innovative solutions, re-engineer processes, and reassess resources to help it meet the challenge of reducing the reliance on paper forms. This includes creating a permanent program to support awareness and implementation of EPA electronic reporting efforts, deploying easy to use Web-based solutions, and providing continuing assistance for EPA trading partners to implement conventional electronic commerce and EDI methodologies. This will insure that the EPA's and Federal Government's goal of decreasing paper usage, streamlining information flow, and

enhancing public access to information will occur in the most timely and efficient manner possible.

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APPENDIX A: ACRONYMS

AIAG	Automotive Industry Action Group
ANSI	American National Standards Institute
API	Atlas Products International/American Petroleum Institute
AS	Authentication Server
ASC	Accredited Standards Committee
BBS	Bulletin Board System
BCA	Business Case Analysis
BPR	Business Process Re-engineering
CAD	Computer Aided Design
CALS	Continuous Acquisition and Life-cycle Support
CAM	Computer Aided Manufacturing
CA	Certification Authority
CEC	Center for Electronic Commerce
CHAPS	Challenge Handshake Authentication Protocol
CIMIS	Common Industry Material Identification Standards
CIS	Certificate Issuing System
CORBA	Common Object Request Broker Architecture
COTS	Commercial Off the Shelf
CNC	Computer Network Corporation
CPU	Central Processing Unit
CRL	Certificate Revocation Lists
CSU	Certificate Signing Unit
CTC	Concurrent Technologies Corporation
DBMS	Database Management System
DES	Data Encryption Standard
DISA	Data Interchange Standards Association
DLA	Defense Logistics Agency
DMR	Discharge Monitoring Report
DMZ	Demilitarized Zone
DOD	Department of Defense
DOS	Disk Operating System
DUSD(L)	Deputy Under Secretary for Defense (Logistics)
EC	Electronic Commerce
ECA	Electronic Commerce Association
ECIP	Electronic Commerce Implementation Plan
ECRC	Electronic Commerce Resource Center
EDI	Electronic Data Interchange
EDIFACT	Electronic Data Interchange for Administration, Commerce and Transport
EDIIW	Electronic Data Interchange Implementation Workgroup
EDO	Economic Development Organization
EEPROM	Electrically Erasable Programmable Read-only Memory
EFT	Electronic Funds Transfer
EOE	Electronic Order Entry

EPA	Environmental Protection Agency
EPO	ECRC Program Office
ER	Electronic Reporting
ERP	Enterprise Resource Planning
ERS	Evaluated Receipts Settlement
FACNET	Federal Acquisition Computer Network
FASA	Federal Acquisition and Streamlining Act
FIPS	Federal Information Processing Standards
FSC	Federal Supply Code
FSG	Federal Supply Group
FTP	File Transport Protocol
GBL	Government Bill of Lading
GE	General Electric
GEIS	General Electric Information Systems
GIS	Geographic Information Systems
HIBCC	Health Industry Business Communications Council
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
I/O	Input/Output
IEC	International Electro-technical Commission
IETF	Internet Engineering Task Force
IP	Internet Protocol
IS	Information System
ISO	International Standards Organization
ISP	Internet Service Provider
ISS	Information Systems Security
IT	Information Technology
ITI	Information Technology Insertion
JIT	Just In Time
LAN	Local Area Network
LMI	Logistics Management Institute
MB	Megabytes
MD5	Message Digit Algorithm
MIME	Multi-purpose Internet Mail Extensions
MIS	Maple Information Services
MIT	Massachusetts Institute of Technology
NAPM	National Association of Purchasing Managers
NASA	National Aeronautic and Space Administration
NAVSEA	Naval Sea Systems Command
NCSA	National Computer Security Association
NECRC	National Electronic Commerce Resource Center
NTIS	National Technical Information Service
OS	Operating System
PACTEL	Pacific Telesis
PAP	Password Authentication Protocol
PC	Personal Computer

PCS	Permit Compliance System
PEM	Privacy Enhanced Mail
PEO	Program Executive Office
PGP	Pretty Good Privacy
PIDX	Petroleum Industry Data Exchange
PIN	Personal Identification Number
PKI	Public Key Infrastructure
PO	Purchase Order
POPS	Paperless Order Processing System
PROM	Programmable Read-only Memory
RAID	Redundant Arrays of Inexpensive Disks
RAM	Random Access Memory
RBAC	Role Based Access Control
RDBMS	Relational Database Management System
RECRC	Regional Electronic Commerce Resource Center
RFP	Request for Proposal
RFQ	Request for Quote
ROI	Return on Investment
ROM	Read Only Memory
S-HTTP	Secure Hypertext Transfer Protocol
S/MIME	Secure/Multi-purpose Internet Mail Extensions
SCRA	South Carolina Research Authority
SET	Secure Electronic Transmission
SGML	Standard Generalized Markup Language
SME	Small to Medium-Sized Enterprises
SMPT	Simple Mail Transfer Protocol
SSL	Secure Socket Layer
SSTD	Surface Ship Torpedo Defense
TAG	Technical Advisory Group
TDE/TDI	Technical Data Exchange/Technical Data Interchange
TCA	Terms and Conditions Agreement
TCP/IP	Transmission Control Protocol/Internet Protocol
TDA	Technology Development Activity
TDCC	Transportation Data Coordinating Committee
TI	Texas Instruments
TPA	Trading Partner Agreement
UCC	Uniform Commercial Code
UDF	User Defined File
UK	United Kingdom
UN/EDIFACT	United Nations Electronic Data Interchange for Administration, Commerce, and Transport
US	United States
VAN	Value Added Network
VMI	Vendor Managed Inventory
Web	World Wide Web
WEDI	Working Group for Electronic Data Interchange

WWW	World Wide Web
XML	eXtensible Markup Language

[i] EDI News, Special Report.